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THE OXFORD COURSE OF FORESTRY.

[*Contributed.*]

There has been lately a certain amount of discussion with regard to the training of probationers for the Indian Forest Service. The Editor of this Journal a short time ago suggested to me that it might interest Cooper's Hill men and others to read a connected account of the course that the Oxford men undergo. I have therefore endeavoured to write one.

The details of such a course naturally vary from year to year especially as the regulations are occasionally modified. The following account gives an outline of what the Oxford training is, and although written from memory is believed to be fairly accurate.

Entrance.—After appointment the probationer enters Oxford in exactly the same way as any other undergraduate or graduate as the case may be. He must pass the same University entrance examination and also whatever other examinations his College may prescribe. He can of course choose his own College. If he is already up at Oxford either as a graduate or an undergraduate

he naturally sticks to his own College, otherwise he has a free choice. He must conform to all ordinary College rules and these may influence him in his choice. For example some Colleges have an entrance examination in addition to "Smalls," some will not take a man unless he is reading for Honours, etc.; naturally this might deter some men. The men who arrived in India at the end of 1911 were drawn from various Oxford Colleges, *e.g.*, Exeter, Christ Church, Keble, St. John's, Trinity, Worcester, etc.

Rules as to residence in College or in "digs" are laid down by the College and Foresters must conform to them as much as other men. As a rule Colleges prefer men to reside two years in College and then to go into "digs." In any case however the University makes a rule that no man may take his degree till he has resided three academical years in Oxford unless he has Junior or Senior standing, *i.e.*, has done a certain course at some other University which is allowed to count as residence in Oxford. St. John's offers certain special advantages to Foresters. As far as can be ascertained this is that that College pays the actual lecture fees over £10 to any man who takes an honour degree.

The Course.—The regulations say that the Diploma in Forestry is granted to members of the University who have—

(1) pursued an approved course of study extending over two years in Oxford;

(2 undergone a course of practical work at places and under conditions approved by the Delegates;

(3) satisfied the Examiners in prescribed examinations.

It will be noticed that it does not say when the practical is to be done; as a matter of fact though the times devoted to practical work may vary, the length of time allotted to it is fairly constant.

Men appointed probationers before 1909 went through this practical work (except in a few special cases), after the two years at Oxford, thus taking a total of three years. Men appointed in 1909 and subsequently have done the same amount of practical training but have done it in the vacations concurrently with their Oxford work thus finishing the whole course in two years. The Secretary of State in the regulations issued for the men appointed

in 1909 laid down that men possessing Science degrees were to do the course in two years and men without degrees were to take three years over the course. It may be of interest to follow the entire course of these men appointed in 1909. They were approved by the Selection Committee, after their qualifications had been considered in July 1909. They then underwent a strict medical examination and started their Oxford work in October 1909.

They can be divided as follows :—

CLASS I.—*Men with Science degrees.*

These men went to Germany during their vacations and so finished their whole course and proceeded to India before the end of 1911.

CLASS II.—*Men without Science degrees.*

These men did exactly the same work as the above except that they did not do the continental work till after the course at Oxford. In October 1911 then they had still their continental work to do and were not ready therefore to proceed to India till the end of 1912. In the case of these latter men, as they take three years to do the course, they could, if they spent it at Oxford, fulfil the residential qualifications for a degree. If then they also did their work abroad in the vacations (and permission to do this can be obtained from the Secretary of State) they could take their degree as well as their diploma in three years. This has been done by several men now in the service. This class II may then be divided into—

(*a*) men who intend to take both the degree and the diploma and who work abroad with class I ;

(*b*) men who do not intend to take a degree.

The Oxford year is divided as follows :—

Men go up about the 9th or 10th of October. They remain in Oxford for a term of 8 weeks, *i.e.*, till about the beginning of December. They then get 6 weeks' vacation. Then follows another term of 8 weeks followed by another 6 weeks' vacation, then a third term of 8 weeks which ends about June 18th followed by the Long Vacation which lasts till the following October. These terms may be called the *Winter*, *Easter* and Summer terms

respectively and the vacations the Christmas, Easter and Long Vacations. The annual vacations are thus longer than the terms, thus in two years the sum of the vacations is more than enough time to do the prescribed 7 or 8 months' practical training abroad. The detailed syllabus of the work is appended to this article, and the following subjects are included:—

During the first year (commencing October 1909)

(*a*) Chemistry of Soils and selected chapters of Organic Chemistry.

(*b*) Geology.

(*c*) General Botany.

(*d*) Forestry, comprising Sylviculture and Forest Mensuration.

(*e*) Geometrical Drawing and Elementary Forest Engineering.

(*f*) German.

During the second year—

(*f*) German (not taken after a man has once been to Germany).

(*g*) Geology of India.

(*h*) Forest Botany, comprising the Structure of Timber, Pathology and *Systematic Botany of Indian Trees.

(*i*) Elements of Zoology, and Entomology.

(*k*) Forestry, comprising Forest Management, Forest Administration, Forest Protection and Utilisation.

(*l*) Forest Law.

(*m*) Surveying.

(*n*) Book-keeping in relation to Indian Forest Accounts (taken with Administration).

These subjects may be divided into—

(*a*) *Principal.*—These form the subjects of the yearly examinations held early in October of each year The marks obtained in them count towards the aggregate which determines a man's final position on the list.

* Taken in the Summer term of the third year and treated as an Auxiliary subject.

(*b*) *Auxiliary.*—In these subjects it is only necessary to satisfy the examiners and, as far as can be ascertained, the marks do not count towards the aggregate. Examinations in auxiliary subjects are held at the end of the term in which the subject is finished and are not held in the University examination schools.

The first year principal subjects are—

(1) Botany ... } Examination, theoretical and practical, total of 6 hours for each subject in October at the end of first year.
(2) Geology ... }

(3) Sylviculture and Forest Mensuration.—The examination is held at the end of the whole course.

In the second year, the principal subjects are—

(1) Forest Botany (only 2 terms) ... } Examination in October of the second year, theoretical and practical, a total of 6 hours for each subject.
(2) Zoology and Entomology ... }

(3) (*a*) Forest Management and Administration. } Examinations at the end of the course.
(*b*) Protection ... ... }
(*c*) Utilisation ... ... }

It will be seen that the Forestry subjects proper are studied all through the Oxford course but that the exanination is held *after* the continental work in October of the second or third year according as to whether the candidate is a two or three year man.

Before going into the actual work the following time-table of the 1st term's lectures is given to show how the work is distributed :—

Monday ...	A.M.	9—12	... Geometrical Drawing.
		12— 1	... Geology.
	P.M.	5— 7	... Geology Practical.
Tuesday ...	A.M.	9—10	... Sylviculture.
		10-15— 1	... Botany.
	P.M.	5— 6	... German.
Wednesday ...	A.M.	9—10	... Mensuration.
		10— 1	... Sylviculture (sometimes with excursion).

Thursday ...	A.M.	9—10	...	Sylviculture.
		10— 1	...	Botany.
	P.M.	5— 6	...	German.
Friday ...	A.M.	9—12	...	Chemistry.
		12— 1	...	Geology.
	P.M.	5— 7	...	Geology Practical.
Saturday ...	A.M.	9—10	...	Sylviculture.
		10— 1	...	Botany.

This shows thirty hours' lectures a week and may be taken as a fair average of the whole course. It may be remarked that the hours of lecture are longer than in any other course in Oxford and are only approached in the Engineering course.

The following notes show how the principal subjects are taught :—

Botany.—On three days a week during the whole of the first year Botany is studied. Each lecture is of three hours' duration. During the first hour a lecture is given, then its subject-matter is demonstrated by practical work in the laboratory. The work is done in the Botanical Gardens opposite Magdalen College. The lectures are delivered by Professor S. H. Vines, Sherardian Professor of Botany, and by his assistant Mr. M. Church. The practical work is usually taken by Mr. Church. The standard of work is rather above that of the Preliminary course for the Honours School except with regard to Fungi and tree orders. In both of these sections the standard is up to Honours.

Text-books :—Vine's Elementary Text-book,
Strasburger's text-book of Botany.
Bower's Course of Practical Instruction.

Geology.—During the first year on three days during the week the honours lectures (one hour) delivered by Professor Sollas are attended. Twice a week during the first year two hours' practical lectures are also attended. These which are usually taken by Professor Sollas's assistant are always preceded by a short lecture on the subject in hand. This work is done in the Geological section of the University Museum.

The text-books are—Watt's Geology for Beginners.
Wood's Palæontology.

Forestry—(*a*) *Mensuration.*—This course was given by Sir William Schlich and illustrated by practical work in Bagley Wood about three miles from Oxford. The course is very similar to that given in the Prussian School at Eberswalde.

(*b*) *Sylviculture.*—This was delivered by Mr. Fisher and based on Schlich's Vol. II, the interest of the lectures being greatly increased by illustrations from forests in India and elsewhere known to the lecturer. Besides several excursions during the early part of the year to familiarise students with the appearance of the various trees, during the summer term many forests in the south of England were visited with Mr. Fisher, *e.g.*, Cæsar's Camp, Cooper's Hill and Great Park, Oxshott, the Chilterns Woburn, Cirencister, Wantage.

The text-books were Schlich's Vols. II and III.

Auxiliary subjects—Meanwhile during the first year of work, *i.e.*, up to about June 18th, 1910, various auxiliary subjects were studied and the examinations in them taken.

The Chemistry (practical and theoretical) was done in the Chemical Department of the University Museum, the Geometrical Drawing and Engineering under the guidance of Mr. N. F. Mackenzie were done in the School of Forestry and by referring to the term's lecture list given it will be seen that considerable time was spent on these two subjects.

By June 1st, 1910, men of all classes had finished their work in the 1st year's course and their examinations in the 1st year's auxiliary subjects. The examinations in the principal subjects Botany and Geology had not been taken. All classes of men now proceeded under Mr. Fisher (since replaced by Mr. Caccia) on the French tour. This tour lasts roughly three weeks and finishes by the middle of July. The places visited are St. Amand (High Forest Beech and Oak and Coppice with standards), Villar's Cotterêts (High Forest Beech and Oak), Nancy (School), Raon l' Etape (High Forest and Selection Forest of Spruce and

Silver Fir and a little S. Pine), Gerardina (Silver Fir and Spruce). On this tour various small pieces of forest work were done such as marking a thinning, etc.

So far all classes of men have been together, now they separate. Class II (*b*) go away when they like to work for their examinations though they often go to Germany to learn something of the language. Classes I and II (*a*) now go to Germany to start their practical course. As a rule there are two or three men together at each place. The places where men are stationed in Germany are Dillenburg, Salmunster (Prussia), Langen, Darrustadt, Heppenhum (Hesse Darmstadt), etc. The actual allotment of time in Germany varies a little, but as a rule a man spends some four or five months at his first place during which time he is taught all there is about the forest he is in, special regard being paid to the various Sylvicultural systems. Work such as marking thinnings, regeneration fellings, etc., is done. At this first place each man makes a Working-plan of a part of the forest as a rule during the last six weeks or two months he is there. During the first part of this time (about the first three months) he keeps a diary of all the work done in German. He also writes an essay in German on all the trees in the district and on any other subject the German Forest Officer may suggest such as "The Wood-felling Regulations," the method of laying out roads, etc., etc.

These Class I and II (*a*) men stay in Germany till about the beginning of October when they return to Oxford for the first year examinations. They have thus put in about 22 months and probably have not begun their Working-plan.

At the beginning of October 1910 all men take their examinations in Botany and Geology.

Forest Botany and Indian Botany.—The Indian Botany is treated as an auxiliary subject and was taken in the Summer term of 1910 by Mr. Gamble. The Forest Botany was taken during the Winter and Easter terms by Professor Somerville, the Sibthorpian Professor of Rural Economy. The time devoted to this was three hours on three days a week. The first hour was devoted to a lecture and the last two hours to practical work. The work is

done in the School for Rural Economy which is attached to the School of Forestry. Besides ordinary Forest Botany the course includes the microscopic identification of coniferous timbers (to their genus) and the microscopic identification of the more important Indian and European broad-leaved timbers. Fungi are again studied but not so much from their botanical point of view (which was done during the first year) as from the point of view of the diseased conditions of trees set up by them. The course also includes the protection of forests against damage by fungi, etc. Professor Somerville also includes in his lectures various other forms of damage such as that done by factory fumes, insolation, etc. Excursions are made to various places in connection with these lectures. The notes form the best text-book on the subject but they are supplemented by such books as Hartig's Identification of Coniferous Timbers, Hartig's Diseases of Forest Trees, etc.

Entomology.—During the whole year three days a week are devoted to this three hours for each lecture. The first hour is devoted to a lecture and the last two hours to practical work in the laboratory. The lectures are conducted by the Assistant Professor of Zoology and the work is done in the Zoological Department of the University Museum. The standard is about equal to the preliminary examination in Zoology except as regards insects, these being studied in far more detail and up to Honour standard. Special attention is paid to all animals and insects of forest importance, protective measures against such being fully gone into.

Text-books:—Bourne's Comparative Anatomy of Animals and various German books on Insects.

Auxiliary subjects.—Meanwhile the following auxiliary subjects have been studied and their examinations taken by June 18th, 1911:—Geology of India by Professor Sollas in the Museum, Indian Botany by Mr. Gamble in the Botanical Laboratory, Forest Law by Sir Ernest Trevalyn in the Indian Institute, Surveying by Mr. N. F. Mackenzie (three hours a week during the whole year besides a chain survey, prismatic compass survey, plane table

survey and the use of the theodolite), and Book-keeping in connection with Forest Management by Sir William Schlich.

Forestry.—Utilisation, Protection, Management and Administration. These are studied during the whole year. The first two were taken by Mr. Fisher and the two latter by Sir William Schlich. The basis of these lectures are Schlich's, Vols. I, III, IV and V.

This brings one to June 18th, 1911. Meanwhile two vacations have passed, the Christmas and the Easter, each of six weeks During this time the men of Classes I and II (*a*) have gone back to Germany. They all return to their original place for the Christmas vacation and usually for the Easter vacation, but this latter depends on the progress of the work. During one or both of these vacations the Working-plan will be completed. This is done mostly in English though in many cases it is more convenient to fill up the various tables in German, this being done as a rule. The amount of help given by the German Officer in the Working-plan varies, but as a rule the students do practically the whole thing themselves. As soon after June 18th, 1911, as possible, the men of Classes I and II (*a*) go back to Germany for a further period of 2½ or 3 months. During this time they visit various forests (usually three), spend about a month in each and on leaving the forest they write a report in English on the forest, its management and everything of interest connected with it. Most men visit the Spessart and the Black Forest, the third place depending on circumstances, but many go to the Sihlwald near Zurich.

On their rearrival in England about the beginning of October 1911, the following examinations were taken :—

By Class I men.—(These men have now finished all their Oxford course, their French tour, their German work 2½ months + 1½ + 1½ + 2½ = 8 months and their examinations in Botany and Geology.)

Forest Botany ...	Three hours' theory and three hours' practical for each subject.
Zoology and Entomology	

Forestry—(*a*) Sylviculture	...	A three hour paper on each subject.
(*b*) Management, Mensuration and Policy.		
(*c*) Protection	...	
(*d*) Utilisation	...	

By Class II (a) and (b).—

Examinations in—

Forest Botany	...	Same as above.
Zoology and Entomology	...	

The Class II (*a*) men have done the same as the Class I men.

The Class II (*b*) men have done all their Oxford course, the French tour, and their examinations in Botany and Geology.

Thus after the October examinations in 1911 the Class I men had finished their course and proceeded to India.

The Class II (*a*) men had finished all the work except their examinations in the Forestry subjects proper. They remained at Oxford working for their degree during their third year and took their schools about June 1912.

The Class II (*b*) men went to Germany to do the practical work finishing about the end of June 1912.

In October 1912 Class II (*a*) and (*b*) men took their remaining examinations, *i.e.*, Sylviculture, etc., and were then ready to proceed to India.

It will thus be seen that a man, working as the Class II (*a*) men work, can in three years take both his diploma and his degree. By going to Oxford at the age of 18 or 19 (as many men do) he can arrive in India at the age of 21 or 22, whereas if he works as a Class I man as he cannot get the degree in less than three years and then has two more years at Forestry, he cannot arrive in India under the age of 24 or 25. It has been put forward that a degree is not of much use to a Forest Officer and also that it tends to make a man rather a specialist in some Science other than Forestry.

May it be pointed out firstly that other Oxford men (in the Civil Service for example) are somewhat inclined to regard Oxford men without degrees as rather, shall we say, abnormal and

are liable to look down on them, and secondly that although it is true that a man who spends three or four years taking a degree in one branch of Science before he takes up Forestry is liable to specialise in that Science, he certainly will not learn enough to be called a specialist taking the two courses at once, though he will learn enough to be able to take up that subject if it should ever become specially useful to do so. He thus has all the advantage of a degree as a "handle" without the alleged disadvantage.

Conclusion.—It is almost impossible to tell what a course really is from a syllabus, as the same syllabus may vary much in detail. Compared with other courses, however, the Forestry course is an exceedingly good one. The writer of this has been informed that the main grounds of the lectures are based on those given formerly at Cooper's Hill. As far as the principal subjects are concerned the lecturers are all well recognised experts and it is merely enough to say that they are the University Lecturers. The Forestry subjects proper were dealt with by Sir William Schlich and Mr. Fisher. Even the auxiliary subjects are taken by such men as Professor Sollas (Geology Professor to the University), Sir Ernest Trevalyn (University Reader in Indian Law), Mr. Gamble, etc, etc. The writer has spent some time at Nancy and has attended the lectures at the Prussian School of Forestry and has no hesitation in saying that taken as a whole the Oxford course is quite as good as both these courses being as a matter of fact very similar to the Prussian course. It is of course quite true that Oxford (and this applies equally to the other suggested training grounds in England) has no scientifically managed forests of any size in the neighbourhood, but it is also true that we have a better training in Germany than the Germans do themselves. It has been remarked to me by young German Officers that we were extremely lucky to be given the opportunities of seeing so many types of management early in our lives and that they themselves practically never had such an opportunity. If one may be permitted to make a slight suggestion it is that enough attention is not paid to French Forests. We go to France first, too early

perhaps to take full advantage of French Sylvicultural conditions and methods.

Later on when we have had a considerable portion of our theoretical training and are thus in a position to fully appreciate Forestry conditions in various localities, it is to Germany we go, thus what we see in Germany influences us far more than what we see in France.

SYLLABUS OF SUBJECTS.

(*a*) **Chemistry of Soils and Organic Chemistry** (one Term).

Constituents, origin and formation of soils; classification and properties. Physical and chemical analysis of soils. Exhaustion and restoration of soils.

Organic Chemistry.

Determination of composition and molecular weight of organic bodies.

Laws of isomerism; geometrical isomerism.

The methods of formation and general reactions of hydrocarbons, haloid esters, alcohols, aldehydes, ketones, acids, amides esters, amines, phenols, aromatic nitro-bodies and sulphonic acids.

Outlines of vegetable chemistry, *viz*:—general character of carbohydrates and proteids, vegetable acids, cinchona and opium alkaloids, terpenes, and essential oils, colouring matters.

(*b*) **Geology** (three Terms).

The morphology and physiology of the Earth, with special reference to the following:—

Igneous rocks as the source of sedimentary material; disintegration. Transportation, deposition and distribution of sediment; its subsequent transformations. Igneous rocks as components of the earth's crust, their gross and minute structure; origin and metamorphosis.

Volcanoes, hot springs, earthquakes and various movements of the sea-level; mountain building and dislocations.

Development of the Earth, especially as recorded in the stratified crust. The scenery, structure and history of British Isles. Fossils as a means of identification of strata. Economic applications of Geology.

(*c*) **Botany (three Terms).**

1. *Physiology.*

Metabolism; the food of plants; assimilation; saprophytism; parasitism (with special reference to pathogenic fungi); respiration; the action of enzymes.

Transpiration and the transpiration-current.

Absorption by the root: root-pressure.

Growth, and its relation to external conditions: etiolation.

The processes and mechanisms of reproduction.

The adaptation of the plant to its environment.

2. *Morphology and Anatomy.*

The Morphology of the vegetative and reproductive organs of the Fungi, Pteridophyta and Phanerogams.

The Anatomy of the Fungi; of certain typical Pteridophyta; and of the Phanerogams.

3. *Taxonomy.*

The classification of plants; the characters of the chief groups of Fungi, with special reference to those forms that are injurious to plants; the characters of the main groups of Pteridophyta: the characters of the principal natural orders of Phanerogams, especially those which include Forest trees.

Text-books:—

Bower: *Course of Practical Instruction* (Macmillan).

Vines: *Elementary Text-book* (Sonnenschein).

Candidates attend the general course given by the *Sherardian* Professor of Botany.

(*d*) **Forestry.** (First year.)

1. *Sylviculture* (three Terms).

The Foundations of Sylviculture. Locality in relation to forest vegetation. Development of forest trees. Character and composition of woods. The sylvicultural systems.

Formation and regeneration of woods. Preliminary works. Direct sowing. Planting. Natural regeneration by seed and by coppice shoots.

Tending of woods during early youth and afterwards.

Removal of undesirable trees. Pruning. Thinning. Sylvicultural notes on forest trees.

Practical work in the Forest Garden, Bagley Wood. Excursions in Term and in the Vacations, including a three weeks' tour in French forests.

Text-book :—

Schlich : *Manual of Forestry*, Vol. II (Bradbury, Agnew & Co).

2. *Mensuration* (two Terms).

Instruments used in forest mensuration. Measurement of felled and standing trees, and of whole woods. Determination of the age and increment of trees and woods.

Text-book :—

Schlich : *Manual of Forestry*, Vol. III.

(*e*) **Geometrical Drawing and Engineering** (two Terms).

Use of drawing instruments. Construction of scales. Reduction of areas. Drawing simple curves. Projection of simple solids. Isometric projection. Printing and stencilling. Tinting, shade lining and use of conventional colours. Drawing plans, elevation and sections of some of the works described under Forest Engineering.

Forest Engineering (based principally on Indian practice).

Use, characteristics and manufacture of materials:—Bricks, stone, lime, mortar, cement, concrete. Roofing of various kinds, Preservation of timber. Type designs for small bridges, culverts, simple bungalow, etc. Road construction and drainage. Timber slides and forest tramways. Wire rope bridges and tramways.

* (*f*) **German**.

Translation from and into German. Colloquial German.

† (*g*) **Geology of India** (one Term).

Physical features of the peninsula of India and its mountain framework. The geologic structure and history of the peninsula,

* Candidates will make their own arrangements for instruction in German.

† For Probationers for the Indian Forest Service only.

Archæan rocks. The Dharwar system, its auriferous deposits, Igneous intrusions. The earliest mountain folding. The Bijawar system. The Kadapa system. The Kurnul and Vindhyan systems, their diamond-bearing beds. Repeated folding and faulting in the Indian and South African table-lands. The Gondwana succession, its plant-remains and coal beds. The glacial deposits of Carboniferous age in India and the Southern Hemisphere. Marine Jurassic and Cretaceous remnants of the maritime provinces: zonal correlation. The Deccan trap. Latirite and bauxite Kankar.

The extra-peninsular area. The Himalayan arc and its foothills; the geological succession of Spiti and Busahir. The Salt range, its stratigraphical succession and salt deposits. The Tithys and its history. Mountain formation; the syntaxis on the Jhelam. Extension of glaciers in the Pleistocene period. Primitive man in India. The valleys of the Indus and the Ganges.

(*h*) **Forest Botany** (three Terms).

1. *The structure and identification of the more important timbers.*

2. *Plant Pathology.*

The more important diseases of trees due to (*a*) physical agency and (*b*) organic agency. (Phanerogamic and Cryptogamic parasites).

3. * *Systematic Botany of Indian trees, shrubs and other forest plants.*

Text-books:—

Hartig: *Diseases of Trees* (translated by Somerville).
Tubeuf: *Diseases of Plants* (translated by Smith).
Gamble: *Manual of Indian Timbers* (Sampson Low & Co.).
Brandis: *Indian Trees* (Archibald Constable & Co.).

The Sibthorpian Professor of Rural Economy will give a course of lectures on Subjects 1 and 2, and a special Lecturer will lecture on Subject 3.

* For Probationers for the Indian Forest Service only.

(i) Zoology and Entomology.

General characters of Animals and essential differences between animals and plants.

Protozoa.

Amœba.

Sporozoa—Malaria, Pébrine.

Metazoa—general characters of Coelentera and Coelomata.

Platyhelmia—outlines of structure and life-history of parasitic forms: liver flukes, tapeworms.

Nematodes—parasitic forms in animals and plants.

Chaetopoda—Lumbricus; structure and bionomics.

Arthropoda—general characters and classification.

Crustacea.

Arachnida, especially Araneina, Phytoptidæ.

Myriapoda, especially Julus.

Insecta.

Insecta.

Detailed anatomy of Periplaneta orientalis.

General account of development and metamorphosis of Insecta.

Classification; chief character of each order; structure, post-embryonic development and habits. Principles on which the orders are subdivided.

Bionomics of Insects.

General relations of Insects and Plants.

Insects which derive their food direct from Plants, with special reference to those which feed on various parts of forest trees: (a) leaves and shoots; (b) stems, bark, wood, bast, etc; (c) roots; (d) flowers, fruits, etc

Galls and gall insects.

Relations of Insects and other animals; predaceous and parasitic Insects; insectivorous animals; Insects as carriers of disease; diseases of Insects.

Interrelation of Insects; predaceous and parasitic Insects; inquilines, commensals, etc.; social Insects.

Mollusca.

General characters. Snails and Slugs.

Vertebrata.

General characters and classification. General account of chief insectivorous Vertebrates; also of Proboscidea, Ruminants (Cervidæ and Bovidæ), Equidæ, Suidæ.

(*k*) **Forestry.** (Second Year.)

1. *Forest Management* (two Terms).

Forest Valuation:—Choice of rate of interest. Formulæ of compound interest. Estimate of receipts and charges. Valuation of forest soil, growing stock and whole forests. The financial results of forestry.

Foundations of Forest Working-Plans (Working Schemes):—The increment. The rotation. The normal age classes. The normal growing stock. The normal yield. The real forest compared with the normal forest.

Preparation of Forest Working-plans:—Collection of statistics. Division of the forest area. Determination of the method of treatment. Determination and regulation of the yield. Control of execution and renewal of Working plans. Samples of Working plans.

Text-book :—
Schlich : *Manual of Forestry*, Vol. III.

2. *Forest Administration* (one Term).

The Utility of Forests:—Direct utility through the produce of forests, the capital which they represent, and the work which they provide. Indirect utility through the effect of forests on the temperature of air and soil, on moisture and the movement of water in nature; the mechanical effect of forests, their sanitary and aesthetic effect.

The State in relation to Forestry:—Duties of the State in regard to Forestry. Protection forests. State forests. Forests of communes and other corporations. Private forests.

Forestry in the British Empire:—(*a*) India: Configuration of the country. The system of rivers. Climate and rainfall. General distribution of forests. Area of forests. Forest policy of the Indian Government. Types of Indian forests and vegetation generally. The forests of the arid, dry, intermediate, and moist zones. (*b*) The Colonies. (*c*) Great Britain and Ireland.

Text-book :—

Schlich: *Manual of Forestry*, Vol. I.

3. *Forest Protection* (one and a half Terms).

Protection against man:—Forest boundaries. Irregularities in removing forest produce. Forest offences. Forest rights.

Protection against animals:—Deer, rodents, birds, insects.

Protection against plants:—Weeds, fungi.

Protection against atmospheric influences:—Frost. Insolation. Wind. Violent rain. Hail. Snow. Rime.

Protection against non-atmospheric natural phenomena:—Water. Avalanches. Shifting sand. Fire.

Protection against diseases:—Red rot. White rot. Stag-headedness. Abnormal needle shedding. Effect of acid fumes from furnaces.

Text-book :—

Schlich: *Manual of Forestry*, Vol. IV, by W. R. Fisher

4. *Forest Utilisation* (one and a half Terms).

Harvesting, Conversion and Disposal of Wood:—Technical properties and qualities of wood. Industrial uses of wood. Felling and conversion of timber. Transport by land and water. Wood depôts. Disposal and sale of wood.

Harvesting and Disposal of Minor Forest Produce:—Utilisation of bark. Forest fodder. Field crops in combination with Forestry. Harvesting of fruits and seeds. Dry fallen wood. Stone and gravel. Forest litter. Grasses for fibre, thatch, oils, mats and baskets; treatment of areas used for their supply. Resin tapping. Caoutchouc and gutta-percha. Other articles of minor produce.

Auxiliary Forest Industries:—Antiseptic treatment of timber. Saw-mills. Wood carbonization. Digging and preparation of peat.

Husking and cleaning of seeds. Extraction of oil of turpentine and rosin from crude resin. Preparation of tanning and paper materials.

Text-book :—

Schlich: *Manual of Forestry*, Vol. V, by W. R. Fisher.

* (*l*) **Forest Law** (three Terms).

Indian Penal Code, Indian Criminal Procedure Code, Indian Evidence Act, The Forest Law of India.

(*m*) **Surveying** (three Terms).

Useful problems in Surveying. Theory of Vernier and Sextant. Theory of laying-out Curves. Plotting Field-work and Computation of Areas surveyed in the field. Methods of mapping topographical details. Conventional signs used in Surveys. Colouring and finishing plans.

Field Course.

Use and adjustment of prismatic compass, dumpy and Cushing's levels. Theodolite and box sextant. Chain surveying. Levelling and determination of relative altitudes. Setting out straight lines, angles, and curves. Traversing by prismatic compass, back angle method, and Gale's method Plane tabling. Contours by Abney's level and tangent scale clinometer.

*† (*n*) **Book-keeping in relation to Indian Forest Accounts.**

II. PRACTICAL COURSE IN FORESTRY.

This course comprises nine months, from the early part of October to the beginning of the following July. For about seven months the students are placed with selected German Forest Officers who will introduce them to the management of well-regulated forest districts which have been under systematic management for a long period of time. During the remaining time the students will visit and examine specially interesting forest districts, so as to become acquainted with the management of forests under varying conditions.

* For Probationers for the Indian Forest Service only

† For the present taught in connexion with Forest Administration

The students will keep diaries in German in which they record their observations, with critical remarks. They will also prepare a complete Working-plan for a small range.

Information as to the arrangements for this course, which can only be made for candidates who have passed the First Examination for the Diploma and have satisfied the Delegates that they have a *sufficient* knowledge of the German language (Syllabus *f*) can be obtained on application to the Secretary to the Delegates.

III. Examinations.

There will be two examinations (partly written and partly practical) for the Diploma.

The subjects of the First Examination will be—

1. *Botany* (Syllabus *c* and *h*).—Candidates will be required to make and describe microscopic preparations, and to identify and describe fresh or preserved specimens of various parts of plants, such as flowers, timber, etc.
2. *Geology* (Syllabus *b*).—Candidates who have obtained at least a third class in the Final Examination in Geology in the Honour School of Natural Science are exempted from this part of the examination.
3. *Zoology* and *Entomology* (Syllabus *i*).

The subjects of the Second Examination will be—

Forestry, theoretical and practical, including Sylviculture and the Protection, Utilization, Management, and Administration of Forests (Syllabus *d* and *k*).

Conditions of admission to the Examinations.

A candidate for the First Examination must—

(1) have been accepted as probationer for the Indian Forest Service, *or* have passed Responsions (or an equivalent examination), *or* have given evidence of having received a good general education, satisfactory to the Committee appointed under Statt. Tit. VI, Sect. IV, § 2, cl. 2;

(2) have been accepted as probationer for the Indian Forest Service; *or* have satisfied the Examiners in the Preliminary Honour Examination in Natural Science, in the

subjects Mechanics and Physics and Chemistry, *or* in some examination accepted by the Delegates as equivalent; *

(3) present certificates showing that he has attended approved courses of instruction in the Subjects *a, b, c, d, e, h, i, k, m.*;

(4) have passed examinations approved by the Delegates in Organic Chemistry,† and in Surveying.

Probationers for the Indian Forest Service are further required to satisfy the Delegates, that they have a sufficient knowledge of Systematic Botany of Indian Trees, the Geology of India, Indian Forest Accounts, and Forest Law (Syllabus *l*).

Every candidate for the Second Examination must

(1) have passed the First Examination;

(2) present certificates showing that he has satisfactorily completed the prescribed course of Practical Instruction in Forestry.

Names of candidates for either examination must be sent to the Secretary to the Delegacy, together with the necessary certificates and a fee of £2, not later than July 1st.

The examinations will be held about September 20th in each year.

Candidates in the First Examination may either (1) offer all the prescribed subjects at the same time, or (2) offer Geology at the end of the first year of the prescribed course, and the remaining subjects (Botany, Zoology and Entomology) in a subsequent examination.‡ Candidates who offer Geology only must present a certificate of attendance at an approved course of instruction in that subject, and pay the fee (£2) for the whole examination; they will be allowed, on presenting the remaining certificates prescribed above, to enter for the remaining subjects at a subsequent examination ‡ without payment of a further fee.

* The following examinations have already been approved:—the Higher Certificate Examination of the Oxford and Cambridge Board, and the Higher Local Examination.

† The following Examinations have been approved under this clause:—the Examination in Organic Chemistry in the First Examination for the Degree of B.M.; or the Final Examination in Chemistry in the Honour School of Natural Science.

‡ In the case of Probationers for the Indian Forest Service, the examination held at the end of the second year of the prescribed course.

ON SOME TIMBERS WHICH RESIST THE ATTACK OF TERMITES.

BY KANEHIRA, FORMOSA, JAPAN.

1 *Introduction.*

The termites or white-ants are among the most destructive insects in our existence. They attack field crops, buildings and trees, among which buildings are most liable.

Our houses in Formosa are mostly made of wood, so there are very few houses which are free from the attack of white-ants.

The surest method of being immune from the damage done by these pests as regards buildings is to use material which is absolutely termite-proof—say stone, brick, concrete, etc. These materials however are too expensive here, besides which, according to our customs, the style of Japanese houses renders it impossible for us to build with these materials and hence the necessity of using wood is evident.

The use of timbers of so-called termite-proof trees or treated timber artificially creosoted would be advantageous.

A certain entomologist declared that the species of termites on our globe are some 360, of which nearly 30 per cent. are in Africa, 18 per cent. in South America, 14 per cent in Malaya, 10 per cent in Australia and its archipelagoes, 9 per cent. in Asia, 6 per cent. in Ceylon and 4 per cent. in Japan. But these numbers will increase as scientific research progresses.

Some of the most destructive termites that attack buildings in Formosa are *Coptotermes formosanus*, Shiraki, *Leucotermes flaviceps* and *Termes formosanus*, all of which do more or less damage. The method of eating up wood is different in the case of each species. *Coptotermes formosanus* eats sapwood leaving the hardwood, making concentric hollow rings, so that in appearance no one can find any damage done on the outside of the timber; this is one of the reasons of their sudden appearance and severity with which the houses are destroyed by termites.

We are dealing here only with damage done in buildings, not with ravages done to forest trees and crops: Malaya is one of the

most painstaking countries with regard to termites. Rubber trees are subject to a great deal of damage caused by *Coptotermes Gestroi*, Wasmann, which is closely allied to our species *Coptotermes formosanus*, Shiraki.

2. *Experimenting with timber against the attack of termites.*

The investigation of the relation between timbers and termites is very interesting and worth trying, though very few experiments have been done, except the following :—

(1) On the prevention of the destruction of timbers by termites. (Transaction of the Entomological Society, London, 1865, Vol. I, pp. 185-186.)

(2) On the ravages of Ants. (The Technologist, London, 1864, Vol. V, pp. 454 456.)

(3) Important Philippine woods. (Bureau of Forestry, Philippine, 1901, p. 91.)

(4) Transvaal Agricultural Journal. (October 1907 and April 1909.)

(5) The Redwood. (Department of Agriculture, U. S. A. Bulletin, No. 38, p. 91.)

(6) Bulletin No. 30, New Series, Division of Entomology, Department of Agriculture, U. S. A.

On December 20th, 1910, the Government of Formosa despatched letters to those tropical countries which suffer from the attack of termites, enquiring about those timbers which are most capable of withstanding the ravages of white-ants. We received answers from the following countries, to whose authorities we tender our best thanks.

Name of the countries, from which we received answers.	*Date of despatch.*
(1) Dutch East Indies (Java) ...	... *a.* January 21st, 1911.
	b. March 6th, 1911.
(2) Hawaii ...	... *a.* January 23rd, 1911.
	b. Do. 27th, 1911.
(3) Bengal, India ...	... *a.* January 23rd, 1911.
	b. March 8th, 1911.

(4) Philippines ...	...	January 28th, 1911.
(5) Bombay, India ...	...	March 9th, 1911.
(6) Singapore ...	...	January 24th, 1911.
(7) Hongkong ...	...	Do. 20th, 1911.
(8) Ceylon	...	February 14th, 1911.
(9) New South Wales ...	...	*a.* February 2nd, 1911.
		b. March 22nd, 1911.
(10) Western Australia ...	...	July 2nd, 1911.
(11) South Australia ...	...	Do. 12th, 1911.
(12) Mexico ...	...	March 13th, 1911.
(13) Peru ..	...	Do. 18th, 1911.
(14) Union of South Africa	...	*a.* February 23rd, 1911.
		b. April 18th, 1911.
(15) German East Africa	...	March 7th, 1911.
(16) Transvaal ...	...	July 19th, 1911.
(17) French Congo ...	...	May 27th, 1911.

I would make this much fuller and give the name of the *authority* in each of these countries that furnished the information. Here the mark* indicates the countries from which we received answers. The abbreviations of those books are also written in the following list. The order of the names of the trees is after Bentham and Hooker.

Reference books.	*Abbreviation.*
(1) Suitability of New South Wales Timber, Government of N. S. W., 1905.	S. of N. S. W. T.
(2) Select Extra-Tropical Plants, F. von Muell, 1880.	S. E. T. P.
(3) Museum of Economic Botany, Kew, 1893, No. 3.	M. E. B.
(4) Wood, G. S. Boulger, 2nd ed., 1908...	W.
(5) Forest Flora of New South Wales, Maiden.	F. F. of N. S. W.
(6) Principal Timber of New South Wales, Government of N. S. W.	P. T. of N. S. W.

(7) Useful Plants of Guam, Contribution from the United States National Herbarium, 1905. — U. P. G.
(8) Important Philippine Woods, Forestry Bureau, Philippine, 1901. — I. P. W.
(9) Transvaal Agricultural Journal ... T. A. J.
(10) *Forestry in Victoria*, Government of Australia. — F. in V.
(11) The Redwood, Department of Agriculture, U. S. A. Bulletin No. 38. — Rd.
(12) Die Termiten. K. Escherich, 1908. — T.
(13) Indo-Malayan Woods, Bureau of *Science, Philippine* — I.M.W.
(14) Timber, J. R. Baterden, 1908 — Timber.

Names of the trees which are not liable to the ravages of white-ants, (termite-proof).

Scientific name.	*Common name.*	*Remarks.*
	Dilleniaceæ.	
Dillenia philippinensis, *Rolfe*	Catmon ...	*Philippine.
	Guttiferæ.	
Mesua ferrea, *L.*	Ironwood ...	*Ceylon.
	Dipterocarpaceæ.	
Hopea plagata, *Vidal* ...	Yacal ...	*Philippine. I. P. W., pp. 89, 91.
	Malvaceæ.	
Lagunaria Patersoni, *Don* .	Tulip-tree ...	South Africa.
	Sterculiaceæ.	
Heritiera littoralis, *Dryand*	Dungon-late ...	*Philippine.
Sterculia acerifolia, *A. Cunn*...	Flame tree ...	*Transvaal.
" diversifolia, *G. Don.*	Carajong ...	Do.
Heritiera sylvatica, *Vidal* ... syn. Sterculia nobilis, *F. Vill., Rev. Vidal.*	Dungon ...	*Philippine.

Tiliaceæ.

Elæocarpus grandis, *F. V. M.*	Mountain ash	W., p. 152.

Rutaceæ.

Citrus Aurantium, *L.* ...	Orange-tree ...	*Mexico.

Meliaceæ.

Cedrela australis, *F. Muell* ...	Red cedar ...	F. F. of N. S. W., p. 57.
,, odorata, *Lour.* ...	Cuba cedar ...	W., p. 157. Timber, p. 159.
Cedrela Toona, *Roxb.* ...	Bastard cedar	*Philippine. *South Africa. *Mexico. S. of N.S.W., p. 7 S.E.T.P., p. 112. M. E. B., p. 17.
,, guaianensis, *A. Juss.*	Bitter wood...	W., p. 123.
Dysoxylon Lessertianum, *Benth.*	Rosewood ..	P. T. of N. S. W., p. 9
Flindersia australis, *R. Br.* .	Native teak....	P. T. of N. S. W. p. 13. S. of N. S. W. T., p. 7. W., p. 138.
,, Oxleyana, *F. von M.*	Long Jack. Light yellow-wood.	W., p. 193.
Khaya senegalensis, *A. Juss.*	African mahogany.	W., p. 209.
Melia Azedarach, *L.* ...	...	*Transvaal.
,, dubia, *Cav.* ...	Lunamadilla	*Ceylon.

Sapindaceæ.

Dodonea viscosa, L. ..	Birch ... Lignum-vitae.	*Transvaal.
Pteroxylon utile, *Eck. et Z.* ..	Sneezewood	W., p. 274.

Leguminosæ.

Acacia Brosigii, *Harms.* ...	..	*Transvaal.
Afzelia palembanica, *Baker* in Hook.	Ironwood. Mirabau.	*Java. W., 276.
Afzelia rhomboidea, *Vidal* ...	Tindalo ...	*Philippine.
Albizzia Lebbek, *Benth.* ...	East Indian Walnut.	*South Africa.
Albizzia Acle, *Blanco.* syn. Pithecolobium Acle, *Vidal.*	Acle .	*Philippine. W., p. 124.
Bauhinia Cunninghamii, *Benth.*	Ironwood ...	*Western Australia.
Calliandra formosa, *Benth.* ..	Ebony ...	*Mexico.
Cassia florida, *Vahl.* ...	Bombay black wood.	*German East Africa.
Dalbergia Sisso, *Roxb.* ...	Brazilian rosewood.	*South Africa.
Erythrophlœum guineense, *G. Don.*	...	*German East Africa.
Erythrophlœum Lim, *Max. Corn.*	Lim-Vang ...	*Cochin-China.
Intsia bijuga, *O. K.* ...	Ipil ... Ifil.	*Philippine. U.P.G., p. 279, I. P. W., pp. 54, 91.
Poinciana regia, *Bojer.* ...	Gold Mohur	*South Africa.
Pterocarpus indicus, *Willd.* ...	Padouk. ... Burmese rosewood.	I. P. W., p. 75. W., p. 236. I. M. W., p. 467.
" Marsupium, *Roxb.*	Bastard teak	*Bombay, India.
Xylia dolabriformis, *Benth.* ...	Ironwood ...	*Bombay, India. W., p. 124. I. M. W., p. 463.

Rosaceæ.

Parinarium Griffithianum, *Benth.*	Liusin ...	*Philippine.
Parinarium Molltil (?) ..	...	*German East Africa.
Prunus Capuli, *Cav.* ...	Caplin ..	*Mexico.

Combretaceæ.

Terminalia Calamansanai, *Rolf.* syn. T. bialata, *Vidal.*	Calamansanay	*Philippine.
Terminalia tomentosa, *W. et A.* ...		*Bombay, India.

Myrtaceae.

Eucalyptus corymbosa, *Sm.*...	Blood wood	W., p. 145 (neg.). Timber, p. 268.
E. corynocalyx, *F. v. M.* ..	Sugar gum ...	*South Australia. W., p. 182.
E. crebra, *F. v. M.* ...	Grey Iron-bark.	*Western Australia.
E. fasiculosa, *F. v. M.* ...	Pink gum ...	*South Australia.
E. gomphocephala, *DC.* ...	Tewark ...	*Western Australia.
E. hemiphloia, *F. v. M.* ...	Canary wood	*South Australia. W., p. 153.
E. leucoxylon, *F. v. M.* ...	Blue gum ...	*South Australia
E. longifolia, *Link.* ..	Wooly-butt...	F. F. of N. S. W., p. 36.
E. marginata, *Sm.* ...	Jarrah ...	*Western Australia.
E. microtheca, *F. v. M.* ...	Coolibah ...	* Do.
E. paniculata, *Sm.* ...	White Iron-bark.	*South Africa.
E. redunca, *Schauer* ..	Wandoo ...	*Western Australia.
E. resinifera, *Sm.* .	Red mahogany	*New South Wales. T. A. J. (1905, July), p. 767. F.F. of N. S. W., p. 69. S. of N. S. W. T., p. 5.

		P.T. of N. S. W., p. 7. W., p. 211.
E. rostrata, *Schlecht* ...	Murry Red-wood.	*New South Wales.* *South Australia. W., p. 181. P.T. of N. S. W., p. 8. S. of N. S. W. T., p. 4.
E. terminalis, *F. v. M.* ...	Blood wood ...	*Western Australia.
Eugenia bracteata, *Roxb.* var. Roxburghii, *Duthie.*	Dinglas ...	I. P. W., p. 91.
Eugenia sp.	Macaasin ...	*Philippine.
Melaleuca leucadendron, *L.* ...	Broad leaved tea tree ...	*South Africa. W., p. 285. T. A. J., p. 767.
Syncarpia laurifolia, *Ten.* ...	Turpentine ...	*South Africa. *New South Wales. P. T. of N. S. W., p. 9. S. of N. S. W. T., p. 6. M. E. B., p. 62. F. F. of N. S. W., p. 19.
Syzygium Jambolanum, *DC.* syn. Eugenia Jambolana, *Lam.*	Jambolana ...	W., p. 193.

Lythrarieæ.

Lagerstrœmia piriformis, *Koehne.*	Batitinan ...	*Philippine.

Samydaceæ.

Homalium luzoniense, *J. Vill.*	Aranga	...	*Philippine.

Compositæ.

Tarchonanthus camphoratus, *L.*		...	*German East Africa.

Sapotaceæ.

Mimusops Elengi, *L.* syn. M. parvifolia, *Br.*	Bansalaguin		*Philippine.
Mimusops littoralis, *Kurz.*	...	...	Timber, p. 187.
Illipe Betis, *Blanco.* syn. Payena Betis, *F. Vidal*	Betis	...	*Philippine.

Ebenaceæ.

Diospyros sp. ...	Ebony	...	*Ceylon.

Apocynaceæ.

Alstonia macrophylla, *Wall.* syn. A. Batino, *Blancho.*	Batino	...	*Philippine.

Bignoniaceæ.

Jacaranda mimosæfolia, *D. Don.*	Jacaranda	...	*South Africa.
Markhamia platycalyx, *Sprague.*		...	*German East Africa.

Verbenaceæ.

Tectona grandis, *L. F.*	Teak	...	*Bombay, India. *Java. *Ceylon. *German East Africa. M. E. B., p. 11. W., p 286. T., p. 160. Timber, p. 813.

Vitex Aherniana, *Merr.*	... Sasalit	..	*Philippine.
Vitex altissima, *L.* syn. Vitex parviflora, *Juss.*	... Molave	...	*Philippine. I. P. W., p. 91.

Monimiaceæ.

Doryphora Sassafras, *Endl.*		...	F. F. of N. S. W., p. 43.

Laurineæ.

Eusideroxylon Zwageri, *T. et B.*	Borneo Ironwood		*Java. W., p. 141. I. M. W., p. 453.
Laurus Camphora, *Nees.* ...		...	*South Africa. T., p. 160.
Ocotea usambalensis, *Engl.*...		...	*German East Africa.
Shorea robusta, *Gaertn.* ...	Sal	...	*Bombay, India.

Proteaceæ.

Grevillea robusta, *A. Cunn.*...	Fern tree Silky oak.	...	*South Africa.

Urticaceæ.

Artocarpus Cumingiana, *Trec.*	Anubing	...	*Philippine.
,, integrifolia, *L.* ...	Jack tree	...	*Ceylon.
Chlorophora excelsa, *Benth.*	Iroko	...	*German East Africa.
	Muellebaum.		W., p. 189.

Juglandaceæ.

Carya sp	Walnut	...	*Mexico.
Juglans sp.	Do.	...	*Do.

Casuarineæ.

Casuarina Lehmanniana, *Mig.*	Bull oak	..	*South Australia.
,, quadrivalvis, *Lab.*	She oak	...	*Do.

Coniferæ.

Araucaria sp.		...	*South Africa.

Callitris (various) ...	Cypress pine ..	*New South Wales. *Western Australia. *South Australia. *South Africa. W., p. 166. P. T. of N. S. W., p. 11. S. of N.S.W.T., p. 6. *F. in* V., p. 80. S. E. T., pp. 91, 92.
Cedrus Deodara, *Loud.* ...	Himalayan cedar.	*South Africa. I. M. W., p. 442. Timber, p. 16 (neg.)
Cupressus sp.	..	*Mexico.
Juniperus sp.	...	*German East Africa. *Mexico. *South Africa.
Podocarpus sp. ... ... (P. elata.)	(Brown Pine).	*German East Africa. W., p. 158. F. F. of N. S. W., p. 87. Indian Forester. Apl. 1912, p. 163.
Sequoia sempervirens, *Endl.*	California Redwood.	*Java. Rd., p. 39. etc.
Strychnos Nux-Vomica, *L.* ...	Snake wood, Strichninery tree	I. M. W., p. 550.

Schinus Molle, *L.* ... *South Africa.
S. terebinthifolius, *Raddi* ... *Do.

3. *Trees which are liable to the attack of termites.*

We received answers from those authorities mentioned before about these timbers which are most liable to the attack of termite and summing up the characters of these timbers, I can class them into two—

(*a*) "Soft wood is most liable."

This answer was given us by the following countries:—Java, Hawaii, Bengal, Bombay, Singapore, Western Australia and German East Africa.

(*b*) "Soft wood which does not have any strong smell nor taste."

This answer was given from the Philippine Islands. New South Wales, South Australia, Mexico, South Africa and Transvaal specified the trees which are most liable, but it is, I think, not worth mentioning these names.

4. *Experiments on the power of resistance of Formosan trees against the attack of termites.*

If we wish to know the resistibility of each tree, we must deal with each in different environments and subject to the attack of each species of termite. We selected a place for experiment at Urai, ten miles from Taihoku, which is very moist and damp and where the termite is very prevalent. We used timbers from the north of the Island. The method of experimenting is as follows:—

(*a*) Experimenting pieces: 59 dried timbers and 41 undried timbers, two of each dimension, in length 1′ 5″ × 1½″ square, and each buried perpendicularly with three inches above the ground exposed. This causes decay to set in quicker than if all were buried.

(*b*)—Date of burying—May 24th, 1911.
Date of First Inspection November 4th, 1911
Date of Second Inspection—May 4th, 1912.

In the following table I used the numbers 1 to 6 in descending order, this indicating (1 the timber which resisted termite or did not decay at all, and (6) that which was all eaten up or destroyed by fungus, medium 2—5 showing intermediate degree.

A.—Unseasoned Timbers.

Name of species.		First Inspection, Nov. 4th, 1911.	Second Inspection, May 4th, 1912.
Alniphyllum pterospermum, *Mats.*	a.	3	6
	b.	5	6
Alnus maritima, *Nutt.*, var. formosana, *Burkill.*	a.	3	5
	b.	2	4
Ardisia Sieboldi, *Miq.*	a.	3	3
	b.	3	3
Daphniphyllum glaucescens, *Bl.*	a.	4	4
	b.	4	4
Diospyros lotus, *L.*	a.	2	2
	b.	2	2
Cinnamomum micranthum, *Hay.*	a.	3	4
	b.	2	4
Cryptocarya sinensis, *Hemsl.*	a.	1	1
	b.	1	1
Elæocarpus decipiens, *Hemsl.*	a.	4	5
	b.	4	5
Engelhardtia spicata, *Bl.*, var. formosana, *Hay.*	a.	3	4
	b.	4	5
Eugenia formosana, *Hay.*	a.	1	1
	b.	1	1
Fagara ailanthoides, *S. et Z.*	a.	2	4
	b.	2	5
Ficus insularis, *Miq.*	a.	3	5
	b.	6	6
Fraxinus insularis, *Hemsl.*	a.	3	5
	b.	6	6
Glochidion formosanum, *Hay.*	a.	2	2
	b.	2	2
Glycosmis cochinchinensis, *Pierre*	a.	2	2
	b.	2	3
Gordonia anomala, *Spreng.*	a.	3	4
	b.	3	4
Heptapleurum octophyllum, *Benth.*	a.	4	5
	b.	4	5
Ilex integra, *Thunb.*	a.	2	2
	b.	2	2
Lagerstrœmia subcostata, *Koehne*	a.	1	1
	b.	1	1
Libocedrus macrolepis, *Benth. et Hook.*	a.	1	1
	b.	1	1
Machilus formosana, *Hay.*	a.	2	2
	b.	2	2

A.—Unseasoned Timbers—(concld.).

Name of species.		First Inspection, Nov. 4th, 1911.	Second Inspection, May 4th, 1912.
M. Kusanoi, *Hay.*	a	1	3
	b.	2	3
M. longifolia, *Blume*	a.	1	[illegible]
	b.	1	2
M. Thunbergii, *S. et Z.*	a.	2	2
	b.	2	2
Mallotus cochinchinensis, *Lour.*	a.	4	5
	b.	5	6
Michelia Compressa, *Max.*	a.	3	5
	b.	1	1
Meliosma squamulata, *Hance*	a.	1	[illegible]
	b.	1	1
Osmanthus lanceolatus, *Hay.*	a.	3	3
	b.	2	3
Podocarpus Nageia, *R. Br.*	a.	1	1
	b.	1	1
Quercus brevicaudata, *Skan.*	a.	3	5
	b.	3	5
" glauca, *Thunb.*	a.	1	2
	b.	1	2
" Junghuhnii, *Miq.*	a.	2	[illegible]
	b.	3	3
" uraiana, *Hay.*	a.	2	2
	b.	2	2
" pseudomyrsineaefolia, *Hay.*	a.	2	2
	b.	2	2
Sapium Liscolor, *Muell. Arg.*	a.	6	6
	b.	6	6
Styrax Hayataianus, *Perkins*	a.	3	4
	b.	3	4
Symplocos spicata, *Roxb.*	a.	4	4
	b.	4	4
Thea sp.	a.	2	4
	b.	2	[illegible]
Trema orientalis, *Bl.*	a.	2	3
	b.	2	4
Wendlandia paniculata, *DC.*	a.	1	1
	b.	1	1
Vitex sp.	a.	2	[illegible]
	b.	2	2

B.—Seasoned Timbers.

Name of species.		First Inspection, Nov. 4th, 1911	Second Inspection, May 4th, 1912.
Acer duplicato-serratum, *Hay.*	a.	4	4
	b.	4	6
Actinodaphne pedicellata, *Hay.*	a.	1	1
	b.	1	1
Adinandra formosana, *Hay.*	a.	3	4
	b.	3	4
Alniphyllum pterospermum, *Mats.*	a.	5	5
	b.	5	5
Aralia spinosa, *Linn.*	a.	4	4
	b.	3	4
Bischoffia javanica, *Bl.*	a.	5	6
	b.	5	6
Bridelia ovata, *Decne.*	a.	1	1
	b.	1	1
Cinnamomum micranthum, *Hay.*	a.	3	4
	b.	2	4
Cleyera ochnacea, *DC.*	a.	5	6
	b.	5	6
Cryptocarya Konishii, *Hay.*	a.	1	1
	b.	1	1
" sinensis, *Hemsl.*	a.	2	2
	b.	2	2
Diospyros Morrisiana, *Hance.*	a.	5	6
	b.	5	6
" eriantha, *Camp.*	a.	2	5
	b.	3	4
Echinocarpus dasycarpus, *Benth.*	a.	3	4
	b.	2	2
Ehretia resinosa, *Hance.*	a.	3	5
	b.	3	5
Elæocarpus japonicus, *S. et Z.*	a.	5	6
	b.	3	4
Engelhardtia spicata, *Bl.*, var. formosana, *Hay.*	a.	6	6
	b.	6	6
Eugenia formosana, *Hay.*	a.	1	1
	b.	1	1
Ficus Beecheyana, *Hook. et Arn.*	a.	5	6
	b.	6	6
" insularis, *Miq.*	a.	3	5
	b.	3	5
" obscura, *Blume*	a.	3	5
	b.	3	5

B.—Seasoned Timbers—(contd.)

Name of species.		First Inspection, Nov. 4th, 1911.	Second Inspection, May 4th, 1912
Fraxinus insularis, *Hemsl.*	a.	2	2
	b.	2	2
Glycosmis cochinchinensis, *Pierre*	a.	1	2
	b.	2	2
Gordonia anomala, *Spreng.*	a.	2	4
	b.	3	4
Helicia formosana, *Hemsl.*	a.	5	5
	b.	3	6
Heptapleurum octophyllum, *Benth.*	a.	6	6
	b.	6	6
Ilex integra, *Thunb.*	a.	1	2
	b.	2	2
Lagerstrœmia subcostata, *Koehne*	a.	2	3
	b.	3	3
Libocedrus macrolepis, *Benth et Hook.*	a.	1	1
	b.	1	1
Liquidamber formosana, *Hay.*	a.	3	4
	b.	3	4
Machilus formosana, *Hay.*	a.	5	5
	b.	5	5
„ longifolia, *Blume*	a.	2	2
	b.	2	2
„ Thunbergii, *S. et Z.*	a.	2	2
	b.	1	1
Melia Azedarach, *Linn.*	a.	3	5
	b.	3	5
Meliosma squamulata, *Hance.*	a.	3	3
	b.	2	4
„ rigida, *S. et Z.*	a.	2	4
	b.	2	2
Michelia Compressa, *Max.*	a.	2	2
	b.	2	3
Myrica rubra, *S. et Z.*	a.	5	6
	b.	6	6
Osmanthus lanceolatus, *Hay.*	a.	2	2
	b	1	1
Podocarpus Nageia, *R. Br.*	a.	1	1
	b.	1	1
Photinia deflexa, *Hemsl.*	a.	3	4
	b.	2	4
„ taiwanensis, *Hay.*	a.	3	3
	b.	3	3

B.—Seasoned Timber—(concld.).

Name of species		First Inspection, Nov 4th, 1911	Second Inspection, May 4th, 1912.
Quercus brevicaudata, *Skan.*	a.	4	6
	b.	5	6
" gilva, *Bl.*	a.	2	2
	b.	1	1
" glauca, *Thunb.*	a.	1	1
	b.	2	2
" pseudomyrsineaefolia, *Hay.*	a.	1	2
	b.	2	2
" ternaticupla, *Hay.*	a.	4	4
	b.	4	4
" uraiana, *Hay.*	a	3	4
	b.	3	4
Rhus sp.	a.	5	6
	b.	6	6
Sapium discolor, *Muell. Arg.*	a.	6	6
	b.	6	6
Styrax formosanum, *Mats.*	a	4	5
	b	4	6
" Hayataianus, *Perkins*	a	2	2
	b.	2	2
Syplocos modesta, *Brand.*	a.	3	3
	b	4	4
Symplocos neriifolia, *S. et Z.*	a.	5	6
	b.	5	6
Thea sp.	a.	3	4
	b.	3	4
Trema orientalis, *Blume*	a.	5	5
	b.	5	6
Turpinia pomifera, *DC.*	a.	1	1
	b.	2	2

The same species of wood were buried again, and the third inspection will be made next year and reported upon.

Termite-proof Formosan trees.

The Formosan people use *Lagerstrœmia subcostata* and *Quercus uraiana*, as they think them to be most resistant against termite. As the result of my experiment I found that *Podocarpus Nageia* and *Libocedrus macrolepis* most resistant *L. subcostata* next to the latter. *Quercus uraiana* is not so resistant but owing to its

straightness and large size the natives use it for building material. The power of resistance, however, must be examined more carefully. In Kiushu and the Luchoo Island, where the houses are attacked by termites more or less, they have a custom of using *Podocarpus Nageia*, *Ternstrœmia japonica* and *Afzelia bijuga*, the last named being similar to the "Ipil" in the Philippine Island.

From the tables in (2) and (3), if we select those timbers which are termite-proof, the following will be the Formosan species :—

Podocarpus Nageia (also Podocarpus macrophylla).
Libocedrus macrolepis.
Eugenia formosana.
Wendlandia paniculata.

The following will probably resist in some degree :—

Lagerstrœmia subcostata.
Bridelia ovata.
Actinodaphne pedicellata.
Meliosma squamulata.
Cryptocarya sinensis (also Cryptocarya Konishii.)
Ternstrœmia japonica.
Heritiera littoralis.
Dodonea viscosa.
Vitex heterophylla.
Terminalia Catappa.
Pistacia formosana.
Cinnamomum Camphora.

The further experiments of another species is necessary to examine the resistibility, for instance, *Chamæcyparis formosensis*, *Aglaia elægnoides*, etc.

5. *Conclusion.*

The reasons which make timber termite-proof.

We arranged the names of timber which resist the attack of termites in (3), but it is not certain in what degree they can resist until careful experiments have been made. Supposing, however, these timbers have resistibility in various degrees (not absolutely), what are the reasons which make them termite-proof? It is a very hard question but we can make the following suggestions :—

(*a*) The presence *in the wood of* some substance which has a strong smell or taste, which insects do not like, of which are—

(i) *Strong smell*—	(ii) *Acrid smell*—
Cedrela Toona	*Terminalia* bialata.
Heritiera littoralis	Pteroxylon utile
Cedrela australis.	Cedrus Deodara.
Tectona grandis	Shorea robusta.
Artocarpus sp	Vitex altissima.
Dysoxylon Lessertianum	,, Aherniana.
Pterocarpus indicus.	*Afzelia rhomboides*
Callitris sp.	,, bijuga.
	Libocedrus macrolepis.
	Cedrela odorata.

(*b*) The presence of some substance which is poisonous to insects, instances of which are—

Vitex Aherniana.	Pithecolobium Acle.
Pterocarpus indicus.	Eucalyptus marginata.
Xylia dolabriformis.	Strychnos Nux-Vomica.
Sequoia sempervirens.	*etc.*

(*c*) Extreme hardness of the wood, *rendering it too* hard to attack, for example—

Erythrophlœum Lim.	Vitex altissima.
Diospyros sp.	*Dodonea viscosa*
Hopea plagata.	*etc.*

We print below a note by the Forest Zoologist, Dehra Dun, on Mr. Kanehira's contribution.—

" The increased attention that the study of termites has received of late has established the fact that the habits of the family are by no means uniform, and that economically the points of difference are of considerable importance. In addition to the true wood-eating termites, there are at least two more well marked groups, *viz.* (*b*) the mound-building termites, which do not normally attack wood and are very rarely destructive, and (*c*) the harmless termites, which never touch timber. The first group contains all the important genera destructive to manufactured timber.

In his list (3), Mr. Kanehira gives 103 species of tropical timbers as "termite-proof" and not liable to the ravages of white-ants. It must be remembered that the durable timbers, while possessing a relative immunity from white-ant attack, are, under certain conditions, readily eaten by the destructive species. In no case, as far as I am aware, has the absolute immunity from the attack of wood-eating genera been established by experiment for any species of untreated timber.

It would be interesting to have more details as to the lines on which the tests with the Formosan timber were carried out before accepting the 16 species of timber given in table (4) as resistant to white-ants. If pieces of wood are buried in soil known to contain termites it does not necessarily follow that the wood will be attacked. The mound building and fungus-cultivating termites, and other soil-living forms will not touch timber under normal conditions, and unless the presence of true wood-eating termites is assured, it is not possible to designate apparently immune timbers as termite-proof. Definite indications of absolute immunity can only be obtained by actual infection with the different species of destructive termites.

The Rev. J. Assmuth, in a recent number of the Journal of the Bombay Natural Society,* points out that the wood-eating species excavate galleries and chambers in wood according to a definite method, and each species appears to possess its characteristic Frassbild. When more is known of the biology of the destructive types, it should be possible to identify the species responsible for the damage from its feeding pattern in the timber

C. F. C. BEESON.

* Journal Bom. Nat. Hist. Soc., Vol XXII, No 2, p. 372.

ENDOWMENT OF A PROFESSORSHIP OF FORESTRY AT OXFORD

The *Indian School of Forestry* was transferred from Cooper's Hill to Oxford in October 1905, on the application of the University. The Secretary of State for India, however, intimated to the University, on March 17th, 1905, that the training of Probationers at Oxford was subject to reconsideration at the end of three years. A Committee was appointed by the Secretary of State in 1908, and, on its recommendation, he decided to throw open the education of Probationers for the Indian Forest Service to any British University which possesses a School of Forestry approved by him. In consequence, the pecuniary assistance hitherto given by the Secretary of State for India ceased on July 1st, 1913.

Until lately, the Oxford School of Forestry has chiefly trained Probationers for the Indian Forest Service. During the past few years, however, a change has taken place at Oxford, so that of the thirty five Forestry Students at present under instruction only seven are Probationers for India, and twenty-eight are other students. The Delegates for Forestry, after due consideration, resolved that every effort should be made to continue the School of Forestry; they informed Council 'that it would be desirable to appoint a University Professor of Forestry, and necessary to make arrangements for the teaching and supervision of the Students after August 1st, 1911, when the Professor of Forestry, Sir Wm. Schlich, had to retire under the age clause of the English *Civil Service Rules*.' *As no foundation for a Professorship of* Forestry existed, Sir Wm. Schlich was appointed Reader in Forestry for a period of three years from August *1st, 1911*, and, by Decree of Convocation, was given the status of Professor of Forestry as long as he should hold the Readership. Thus, temporary arrangements have been made to continue the School

Sir Wm. Schlich, however, cannot hope to continue the work much longer owing to his advanced age, and he informed the Delegates that he had started a fund for the endowment of a Professorship of Forestry, so as to provide an income for his successor. On the occasion of his retirement from the Government Service, his former pupils presented him with a cheque for £267, to which he added £233, and subscribed £500 as the first donation to the endowment fund. Considering it desirable to call, in the first place, on the University institutions, he appealed to the several Oxford Colleges, some of which subscribed temporary contributions amounting to £875, while St. John's College agreed to give a permanent contribution of £50 a year. Indian Forest Officers and a few friends contributed further sums amounting to £190 *8s. 8d.*

The University having thus shown its goodwill, Sir Wm. Schlich submitted the case to the Secretary of State for the Colonies, who forwarded it to the various Crown Colonies, and these responded most liberally. The Secretary of State for India also

gave a contribution. In this way the sums detailed in the appended list have been obtained. They amount to the following totals:—

(1) Donations towards endowment ... £3,644 1s. 8d.

(2) Permanent contribution by St. John's College of .. .. £50 a year.

(3) Temporary contributions by several Colleges, £875.

The sum of £3,644 1s. 8d. has been made over to the Curators of the University Chest, who have invested it. The donations so far received are, however, not sufficient for a permanent endowment, for which not less than £10,000 are required, and further contributions will be gratefully received by the undersigned, for transmission to the University Chest.

The question of the development of Scientific Forestry and Afforestation is under the serious consideration of the Board of Agriculture. A Committee of nine members, appointed by the President of the Board of Agriculture to advise him on matters relating to the development of Forestry, has been asked in the first instance (1) to consider and advise upon the proposals for a forest survey, (2) to draw up plans for experiments in Silviculture and for a demonstration area, (3) to advise as to the provision required for the instruction in Forestry. As regards the training of Forest Officers, the School of Forestry at Oxford has been specially mentioned, and it has been pointed out that this, and one or two other schools, only need to be extended to provide for the instruction of the staff required to carry out the policy of the Government. There is, therefore, every probability that the number of scientific foresters required by this country will considerably increase, quite apart from the needs of India and the Colonies. It is hoped that Oxford will take its share in the movement. The School of Forestry at Oxford has been developed to such an extent that it may, without fear of contradiction, be defined as the most complete Forest School in the British Empire. There is an adequate building for instruction, to which, at this moment, an institute for research in the Diseases of Trees is being added. The several branches of Science auxiliary to Forestry are fully represented, and Bagley Wood, two miles distant from Oxford,

is at the disposal of the School for practical instruction. The most important step now is to provide a foundation sufficient to secure permanently a fully competent Professor of Forestry.

List of Contributions up to October 1st, 1913.	£	s.	d.
Sir W. Schlich and his former pupils	500	0	0
Indian Forest Officers	110	8	8
Sir Thomas Raleigh	50	0	0
Professor and Mrs. Poulton	10	0	0
University College, Oxford	10	10	0
Mr. A. F. Broun, late Indian and Sudan Forest Services	10	0	0
His Highness the Maharajah of Travancore ...	200	0	0
The Government of the Gold Coast	500	0	0
" " Sierra Leone	250	0	0
" " the Federated Malay States ...	500	0	0
" " Ceylon	500	0	0
" " Southern Nigeria	500	0	0
Mr. V. G. Bell, Forest Officer, Straits Settlements	3	3	0
Secretary of State for India	500	0	0
Total	£3,644	1	8

Annual Contribution by St. John's College, indefinitely, £50.

Temporary Contribution by Oxford Colleges :—	£	s.	d.
Christ Church, £100 for three years	300	0	0
Balliol College, £25 for three years	75	0	0
Brasenose College, £50 for three years ...	150	0	0
* New College, £50 for five years	250	0	0
Jesus College, £10 for five years	50	0	0
Magdalen College, for one year	50	0	0
Total ..	£875	0	0

W. SCHLICH.

SCHOOL OF FORESTRY, OXFORD:
October 1st, 1913.

* Conditionally on £250 being obtained from other Colleges.

INDIAN FORESTER PRIZES

The Committee of Management of the *Indian Forester* have decided to offer annual prizes to the Rangers' classes at Dehra Dun, Coimbatore, and Pyinmana of the value of 50 rupees in each case, as also an annual prize of the value of 75 rupees to the Provincial Service class at Dehra Dun. It will be left to the discretion of the various Schools and Colleges to award the prize in such manner and for such subject as they think fit. Thus the prize may be in the form of books, of a medal, a box of instruments, etc. It may be awarded for the most proficient all-round student, or for the best student in Sylviculture, Botany, etc. If desired it may be offered to the student, past or present, who has contributed the best essay or article on any Forestry subject, in which case the article will be published in the *Forester*.

The Committee of Management has no wish to bind down the College or School in any way, and trusts that by the offer of these prizes, the bond of union between the *Forester* and the Provincial and Subordinate Services will be strengthened.

The award of these prizes will come into force in 1914.

RAI BAHADUR KESHAVANAND.

We hear with much pleasure that the above officer who for some years was Assistant Instructor at the Dehra Forest College, from which post he retired last year, has been asked to join the Council of Regency in the Tehri State as the third member, and has accepted the offer made him This is a well-paid appointment, requiring the exercise of much discretion and patience. We consider the choice made an excellent one, and know of no one more suited to the post than Rai Bahadur Keshavanand to whom we offer our congratulations.

EXTRACTS.

TIMBER SEASONING.

In describing his latest researches in the electrical seasoning of timber, Dr. Nodon claims that his process can be applied in the forest where the trees are felled, since no cumbrous or costly equipment is required. The process depends on the electrolysis of cellulose and its derivative. The newly-felled trees are sawn into thick planks and laid on a false flooring one on top of the other, with the interposition, however, of moistened matting or similar material between each layer, to act as electrodes for the introduction of alternating current which is passed for ten hours or so. The effect of the current is to produce chemical changes in the cellulose

and the sap, rendering them impervious to decay. Further, the sap loses those gummy and hygroscopic characteristics which normally prevent rapid drying.

It is claimed that timber thus treated is ready for use a few weeks after it is felled, and is harder, stronger, more homogeneous, easier to work and less warped by moisture than timber which has been seasoned by the ordinary air-drying process. Paving blocks treated by the process are said to have been in use at Bordeaux for six years without showing appreciable deterioration.—[*Times of India*.]

PAPER YARN.

A correspondent writes to the *Manchester Guardian*:— When paper yarn was first introduced commercially, rather over twenty years ago, those financially interested in it had high hopes of its replacing jute to a large extent, and especially in the manufacture of sacks. Up to the present, of course, these anticipations have not been realised, though it must be admitted to have established itself as a standard fibre, and is now employed either alone or more generally in combination with cotton, jute, linen, or woollen yarn, in the manufacture of quite a wide range of goods. There are two systems used in the production of paper yarn, both of which are of German origin. In the first process, known as the Kellner-Turk system, the wet paper-pulp, whilst still on the paper machine, is divided into small sections, pressed, dried, and subsequently twisted—or, as the makers term it, spun—on special machinery, whilst in the second process, the Claviez system, dry, unsized paper is cut into narrow strips of from 6 to 12 mm. in width, wound on to bobbins, and then spun on a special frame.

There are several modifications of these processes worked by various Continental firms, and although the first mentioned would appear to have economic advantages, it presents many more practical difficulties, and seems to be losing ground in competition with its rival. It can be readily understood that paper yarn is by no means easy to weave. Its stiffness makes it difficult to

manipulate, but with care it can be satisfactorily woven on the ordinary jute loom Hitherto, the chief use of piece-goods from paper yarn has been for inside decorative work, and as upholstery material. It is also made use of for floor covering, whilst material made with a jute warp and paper weft is finding increasing employment in the manufacture of linoleum. Strenuous efforts have been made to popularise it as sacking, and the high prices which have prevailed for jute for some time past have favoured its employment in this direction.

Ordinary paper yarn, however, has several inherent qualities which handicap it seriously as a substitute for jute in the manufacture of sacks. Owing to its smooth, stiff nature any but rather coarse material packed in these sacks is able to work its way out through the interstices in the fabric, whilst the cord with which the sacks are tied is very apt to slip, and the sacks are, moreover, difficult to carry. Jute warp and paper weft give better results, and sacks made from them are used to some extent. Recently, a new fabric from paper yarn has been put on the market under the name of "Textilose," in which the smoothness inherent in the usual qualities is overcome by first covering the paper with a fine fleece made from cotton waste. The process has been patented by Claviez, one of the original workers on this subject, and is said to yield a product suitable for packing of fine, powdery substances, and it appears to be used rather freely on the Continent for packing cement. Those who are backing it financially seem to have great confidence, for works for its manufacture are either running or are in course of erection in most Continental countries and in England.

One field in which paper yarn has advantages over jute is in the manufacture of sheeting for baling woollen goods, for here serious damage may be caused by the loose fibres attaching themselves to the contents of the bale if the paper covering in which they are first wrapped gets broken through. Although piece-goods from paper yarn have not made very much headway up to the present, the outlook is not really unpromising, and it is likely that more will be heard of this material in the near future.

A company has just been registered in Paris, with a capital of 11½ million francs, which may be increased to 20 million francs, to take over several European textilose concerns. The combination will include the English Textilose Manufacturing Company, Limited, Manchester, the Manufacture Française de Textilose, Paris, the Manufacture Belge de Textilose, Brussels, and the firm of Fratelli Borghi, Milan. The style of the new undertaking is the Societé de Textiloses et Textiles. The German works engaged in the manufacture of textilose are being considerably enlarged. It is reported that another product made by a new patented process from paper yarn, and which is said to have advantages over other similar products as a substitute for jute, will shortly be put on the market under the name of "Stranfa." There is not much information available regarding this latest arrival, but the textilose interests profess to have no fear of it as a competitor, asserting it to be only suitable for coarse goods.—[*Indian Trade Journal.*]

A FORESTRY EXPERIMENT IN CANADA.

An interesting forestry experiment is in progress at Lachute, in the Province of Quebec. An extensive tract of country, formerly devoted to the growing of barley, became deprived of its humus and other binding elements, and deteriorated into a desert of fine dust Held together in places by patches of coarse grass and hollowed out in others by the winds, the country resembled a rolling sea. The Quebec Government undertook its reclamation, and the results of the work to date are an interesting study for those interested in forestry. Of 17,000 two-year-old white pine trees planted a year ago 13,000 are still living, while of 18,000 white spruce of the same age only 5,000 have come through the year successfully. On the other hand, 3,000 white ash and 800 elms, though slightly frozen, endured the winter practically without loss. This year the dead pine and spruce trees are being replaced, the precaution being taken to plant about their roots beach grass, which, by preventing the erosion of the soil through the frequent winds, gives the young trees a chance to get root-

hold and grow. Last year the total area planted was 21 acres This year, with 12 students working at the rate of about 8,000 to 10,000 seedlings a day, 25 to 30 acres have been planted. The cost is approximately 15 dollars per acre, though it is estimated that, if the planting could be done on a larger scale, the cost would not exceed 5 dollars or 6 dollars an acre.—[*Indian Planter's Gazette.*]

SAND WASTE RECLAMATION.

A type of land reclamation, to which it will be necessary to turn more attention shortly, is in connection with coast sand dunes, sand spits and sand wastes, regarding which a series of interesting articles are appearing in the *Surveyor*. Work of this nature has been most successfully undertaken in the South of France, accounts regarding which appeared not long ago. Mr. Case, writing in the *Surveyor*, gives numerous instances of the destruction of villages and fertile fields in England by the advance of moving sand, which commonly moves in dunes with a crest up to 100 feet high and at a rate up to 80 feet per year. It is believed there would in most cases be no movement were the dunes left uninterfered with, as they tend to produce first a bushy growth and afterwards even a forest, which effectually fixes them. Any attempt to remove the growths inevitably results in giving them an impulse to move inland, which they do by the action of sea-breezes rolling the coarser sand along the surface and blowing the finer sand over the crest on to the lee slope. There are records of an attempt to cultivate a sand dune which had fixed itself by vegetation resulting in a resumption of the moving and eventual overwhelming of the whole property. When sand dunes are moving inward and the blown sand of the foreshore is not being replaced by fresh drift of the sea, the result is erosion of the coast and permanent loss of land. It has not yet been properly realised that reclaimed sand wastes may in time be turned into valuable forest land; and yet there is evidence that the dunes of Holland really were, before Roman times, vast forest areas stretching to the margin of the sea; and that only when the forests were removed

did the dunes resume their bare, shifting character. This much then can be taken as certain. Dunes if left to themselves will in time grow vegetation and fix themselves, and they may also be helped to do so in a comparatively short time by judicious artificial planting, as has actually been effected in France. There is much stir just now about reclaiming swamp lands for cultivation; there ought to be equal enthusiasm about reclaiming sand wastes for forest, the one being as feasible as the other, and one might also say as necessary for the well-being of a country.—[*Indian Engineering.*]

LEMON-OIL SUBSTITUTES.

The article below is from the *Chemist and Druggist* of September 20th:—As a result of the high level of prices which lemon-oil has reached this year, there has been a considerable demand for "artificial lemon-oil" or "lemon substitutes" among the smaller aërated-water manufacturers in this country. Consequently the general taste of the public for lemon flavour is being debased, and unless one's purchases are confined to brands having a first-class reputation, the possibility is that the consumer will drink a "lemonade" quite innocent of the genuine oil-of-lemon flavour. As a fact, the makers referred to have been driven to various kinds of expedients, and as they cannot raise the price of lemonade to the public, they are using flavouring substitutes, the bulk of which will not bear the most superficial examination. We understand that the basis of these substitutes is invariably citral extracted either from lemon-grass oil or from *Eucalyptus backhousia* oil, and their bulk consists of some indifferent substance. When lemon terpenes were cheap this indifferent substance was lemon terpenes, and the illogical and absurd condition existing was that the true lemon citral was extracted from lemon-oil by the manufacturer and sold as terpeneless lemon-oil, and lemon-grass citral added to the terpenes, which now become "artificial lemon oil—just as good as the natural." If so, why extract the natural and replace it by lemon-grass citral? At the present moment lemon terpenes are very high in price, so the poorer makes of "artificial lemon" are

mixtures of citral with Greek turpentine, caraway terpenes, lime terpenes, and various other more or less indifferent bodies. But the flavour of lemon in the finished product can, in many cases, only be faintly noticed after the label has been read, the nasty flavour of lemon-grass citral and turpentine, etc., being easily discerned.

The sale of "artificial lemon-oil" is, however, more or less open, and is honest. But the second cause of the inferiority of such substances as lemonade is the insane desire for cheap oil. We know of plenty of oil being sold to-day to cheap aërated water makers and confectioners which contains about one per cent. of true lemon citral, 25 per cent. of lemon terpenes, 20 per cent. of lime terpenes, 40 per cent. of Greek turpentine, and the remainder a little orange terpenes to increase the optical rotation. The point naturally arises as to whether the law cannot get at these cases. Apparently until the Legislature makes the act of adulteration an offence, and the wholesale sale of adulterated foods and drugs as well, the Sale of Food and Drugs Acts cannot, without great difficulty, protect the public from the fraud. The retail vendors of the lemonade would be the most likely persons to get at, but the analytical difficulties are at this stage of the fraud practically insuperable. The same is true with the Merchandise Marks Act, as lemonade means a beverage flavoured with lemon, and it cannot be averred that this poor product is innocent of lemon Nevertheless, there is a case for inquiry and observation by the authorities.

As regards the market for lemon-oil, this is the period of the year when orders are usually placed for the purchase of new crop, but for several seasons past it has become increasingly difficult for consumers to know what course to pursue in regard to their contracts, owing to the tactics of speculators. The consequence has been that buyers of new crop have again held off as long as possible, and this absence of demand has brought about an easier feeling of late in the primary markets, speculators offering new oil at rather more reasonable prices, which, however, are still considered too high in view of the fact that the crop of lemons is from 40 to 50 per cent. larger than last year, which, however, was a small one,

It is anticipated that the price of the new-crop oil should this year be between 9*s*. and 10*s*. per lb. (but 12*s*. has actually been paid), and several important exporters advise their customers that if prices during the next few weeks should show a decline of, say, 2*s*. to 3*s*. per lb., then half their requirements should be covered. Meanwhile the "bulls" have temporarily got the upper hand again and although they may advance prices a further 2*s*., it is difficult to see how their tactics can prevail, with continued abstention of buying.—[*Indian Trade Journal.*]

BLOWING OUT A FOREST FIRE.

When the members of the Eastern Foresters' Association held their meeting at Wanakena, in July, they were treated to an exhibition which they viewed with a great deal of interest. This was a demonstration of controlling forest fires with dynamite.

Broadly speaking, there are two kinds of forest fires—the over-head fire, where the flames leap from tree to tree, and the smouldering fire in what is called the forest duff, which is the deposit of dried leaves sometimes a foot or two deep. Of the two, the fire in the duff is perhaps the more menacing, as it smoulders for a long time, running great distances, is difficult to detect at the distances of the Observation Stations, and is liable to break out in the open in several places at once.

The method adopted heretofore for controlling the fires in the forest duff has been to dig a trench by hand with a two-fold purpose of blocking the progress of the fire and of exposing sand or loam, which can be thrown on the burning duff to extinguish the fire. At the Wanakena demonstration, Mr. S. R. Russell and Mr. E. R. Angst, of the du Pont Company, laid out a curved line of holes about 250 feet long, making them about 15 inches deep and about two feet apart, using a punch bar to make the holes. Into each hole was loaded one cartridge of $1\frac{1}{8} \times 8$ Red Cross straight 20 per cent. strength dynamite, primed with a four foot No. 6 electric blasting cap. These were connected in over-lapping series so that the two free ends of the circuit were at one end of the line

where they were connected to a duplex cable leading wire. The fire was started on the windward side in the forest duff and stimulated with a barrel of kerosene oil. A wall of fire twelve feet high bore down on the buried dynamite and when within a few feet of the line of holes the charge was exploded. The flame was extinguished by the blast from the explosion as you would blow out a candle flame. A ditch from four feet to five feet wide, two to two and one-half feet deep and 250 feet long was made which cut off and blocked the progress of the fire or any smouldering embers that remained, absolutely. The ground through which this ditch was made was of such character that it would have been almost impossible to dig it by hand, owing to the mass of thick underbush, fallen logs, etc. The "blasted ditch," besides extinguishing the flame of the fire and cutting off the path of the smouldering fire, also exposed the earth below the duff so that the men could get into the ditch with shovels and throw the sand on the fire. The whole operation took only a few minutes and cost about $10.20. The members of the Association were very much impressed by this demonstration, as were also a number of representatives of private lumber companies, who announced their intention of supplying their watch stations with the necessary dynamite for combating forest fires by this method in the future.—[*American Forestry.*]

SHEEP GO FOUR MONTHS WITHOUT WATER.

Washington, June 28th. -Sheep on the Nebo National Forest, Utah, go four and a half months without water except for such moisture as they get from the dew and the juices of forage plants.

Grazing sheep on a range entirely destitute of water is a recent innovation due to the increasing demand for forage and the efforts of the Forest Officers to find a place on the forest ranges for all the stock that can safely be admitted. The area on the Nebo which has now proved usable by sheep is high and rocky, a portion of it being above timber line, and it has neither springs nor streams of sufficient size or accessibility to be used for stock watering purposes. The grazing season lasts from June 15th to

October 31st, and during this period of four and a half months the animals do not get a drink.

Under such conditions, however, the sheep have done extremely well, and last year's lambs from this range had an average weight at the close of the season of 68 pounds on the Chicago market, which was rather above the normal weight from that vicinity.

In one area on the Targhee Forest in Idaho, sheep get water only twice during the four-months summer grazing season. There is no water on the range, but the sheep are driven to a nearby stream lower down the mountain side. Lambs from this range weighed 65 pounds on the Chicago market – [*American Forestry.*]

"TEKTON."

A new building material, known as "Tekton," which is being introduced by Messrs. Ollendorff and Clarkson (Limited), of 163, Hope-street, Glasgow, is stated to be of the nature of artificial wood and to possess the strength and durability of concrete. The ingredients of which the material is formed are magnesite, granulated slag, chloride of magnesium, and "wood flour;" and its principal properties are that it is porous, has a low heat conductivity, and is sound-proof, fire-resisting, odourless, and not liable to develop dry-rot. It is made in boards and planks, or it may be modelled in any required shape. It is claimed to be particularly suitable for use in the construction of portable buildings which have to be erected rapidly and cheaply. The Zeppelin Airship Company have entered into a five years' contract by which they will employ Tekton for the construction of all their hangars.—[*Capital.*]

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THE TECHNICAL TRAINING AND THE WORK OF THE FOREST DEPARTMENT FROM A COMMERCIAL POINT OF VIEW.

After reading the leading article in January's *Forester* describing the Forest Education at Oxford (and we take this opportunity of thanking the author for his lucid description), which seems to us from a purely sylvicultural point of view to be as good as can be given in Great Britain, we have been somewhat struck with the limited scope of Forest training generally, and the want of endeavour during, and after, the period of training to demonstrate the potential economic value of the bye-products of our Indian Forests, and the best methods of dealing with them.

We doubt if it is fully realised that, in India at any rate, it is just as much the business of the Forest Officer to sell his products to the best advantage as it is to grow them.

In continental Europe a technical training in the uses of the various Forest bye-products is perhaps not required to the same extent as out here, since their uses are well known, and there are always experts at hand to give advice regarding their

utilization, while it is not difficult to raise capital on any reasonably hopeful project in connection with this utilization. In India matters are different and daily we see valuable products going to waste owing to ignorance as to their uses and as to the best means of rendering them acceptable to the mercantile world. This leads us to consider whether some form of technical education with a view to indicating the most promising methods of utilizing the bye-products of our forests accompanied by actual demonstration at factories and elsewhere is not a desideratum.

We are inclined to think that at present in the selection of recruits too great stress is laid upon University training, and that time is too apt to be wasted on purely academic distinction, much of which might more profitably be employed elsewhere and otherwise.

Preference is now being given to candidates who have already secured an Honor's degree in Science. To obtain this a residence of some three years at an University is necessary. It is therefore usually five years, possibly more, between the date of our recruits joining the University and the date of their sailing for India, and during this somewhat lengthy period they learn little that will be of much assistance to them in the development and utilization on a practical scale of our bye-products, apart from the fact that they arrive in the East at too advanced an age.

We certainly require sound sylviculturists and the recruits now joining us appear, on the whole, to have had a good training certainly in theory, and to some extent in practice in this subject, if they have a good knowledge of Botany so much the better, while a veneer of Chemistry, Entomology and Geology may, under certain circumstances, be of advantage if not acquired at the expense of other and more useful knowledge at present too often neglected.

Owing to the creation of the Forest Research Institute and the progressive policy of the Government of India in connection therewith, a great impetus has lately been given to an examination into the possibilities of various Forest industries, such as the preparation of paper-pulp, tannin extracts, the destructive

distillation of wood and the antiseptic treatment of sleepers, and it seems not impossible that the value of the products of these industries may, at no very distant date, approach the value of the timber that we annually place upon the market. It has, for example, been authoritatively stated that India possesses grass areas, now of little or no value, large enough to supply paper-pulp for the world's requirements, and an independent writer in *Commerce* of the 16th November 1913, who has been looking into this, bears out this statement.

Again, it is no secret that the tannin extracts of Europe are becoming insufficient to meet trade requirements, and well informed experts do not hesitate to express an opinion that at the present rate of supply and demand a trade crisis may well ensue in some twenty years' time unless other tannin materials are made available. Further, with the extension of railways, the demand for sleepers is becoming acute, pointing to the urgency of adopting some treatment that will render durable timbers that are now held to be unsuitable. Thus it is of importance not only in the interests of our Forest revenue and development, but also in those of the commerce of the world, that we should do our utmost to utilize the crude materials that lie at our door. One of the main difficulties as pointed out above that confronts us in making the best use of these materials is, that we have no officers of technical and expert practical knowledge to show the most satisfactory ways of doing it.

Surely, then, instead of placing such a high premium on science and academic knowledge, it would be more to the advantage of the Department if we were to give our recruits some technical education and demonstration in the preparation and manufacture of commercial articles that could be supplied by the Indian Forests. For example, in place of insisting, or trying to insist, on the possession of an Honor's degree in Science, which may be of little practical use to a candidate in after life, why should we not preferably call for candidates who have had some practical training and experience in the manufacture of articles that India can well supply? Which is the most useful to us, a man who has

spent three years at College in acquiring an Honor's degree in Geology, or a man who has been through a pulp-mill, who has had experience in the manufacture of tannin extracts, of matches or of acetones by destructive distillation, or one who has studied saw-mills, and has also an intimate acquaintance with the best methods of distilling essential oils? The reply to our mind admits of no doubt. What we wish very clearly to bring out is that our Department as far as sylviculture is concerned may be up to the mark, but that as the managers of one of the largest commercial concerns in the world, we are behind the times, owing to absence of technical and commercial training and owing to the want of inducements and opportunities of studying the conditions of special industries before reaching this country and, we would add, while on leave. We do not imply that a few months' study of one or more special industries will produce an expert, but it would go far towards imparting very useful knowledge which would enable an officer to form an opinion on the feasibility of creating or furthering a special industry, of which he has made some study, in a given locality. An officer on leave now and again puts in a few months on the Continent with a view to keep himself in touch with the developments of European Forestry; this is of course highly praiseworthy. We believe, however, that he would often be of greater value to his Department if he had put in this time in studying some well-defined Forest industry or industries with a view to initiate or push such out here, yet we seldom see this suggested or any inducement given to such technical study. Instead of trying to capture recruits with Honors' degrees in Science, *i.e.*, those who have already been three years at an University, why should we not take them at an earlier age and in addition to their present sylvicultural training give them a technical training, both theoretical and practical, with a view to indicating to them how best to utilize our Forest bye-products? Extended theoretical education in connection with these special industries—and by extended we mean in far greater detail and of much wider scope than given at present,—might possibly be given during the two years' Forest course instead of, or at any rate in addition

to, instruction in subjects that will afterwards prove of little value while the practical demonstration might follow later on at various factories and centres in the United Kingdom and on the Continent under the guidance of an officer who has made a special study of the best means of utilizing our bye-products, *e.g.*, an officer who has held the post of Forest Economist. We believe that if something of this sort were attempted, Indian Forestry would receive considerable benefit from an economic point of view, and that any additional expense incurred would be amply repaid.

We pass now to the work of our staff looked at from a commercial point of view. A lengthy stay at an University is expensive and sylvicultural knowledge is acquired at considerable cost to the *individual* as *well* as to the *government of the country*. Thus an officer after arrival in India should be afforded every opportunity of using to the full the knowledge that he has gained. Very often this is not the case, *e.g.*, men with a high scientific training are frequently employed in sorting and measuring up timber, girdling trees, on extraction, and transport of produce and similar routine work that could just as easily be done by men with an ordinarily good, though not scientific, education, of sound common sense, and if with some commercial training so much the better. These men inasmuch as they have not had to sink money on a highly technical and expensive education would be available at a lower rate of pay, and might be taken on temporarily in such numbers as deemed necessary to reinforce the regular staff and to allow its members to be employed on work that their European training has specially fitted them for. In the Public Works Department we read of temporary engineers, then why not temporary Forest Officers who might, in Burma, for example, be engaged in the departmental extraction of teak and other valuable timber that is now being chiefly carried on by highly-trained officers or middlemen? We believe that it is not generally realised that, on the one hand, owing to the limited scope of the training of our Forest Estate Managers and on the other to the employment of scientifically trained men on work that calls for no scientific acquirements, work that could as well be done and ought to be

done by a separate untrained staff which is non-existent, we are losing lacs of money every year, quite apart from the fact that we are *failing as a Department* to utilize the possibilities of our forests for the greatest benefit of the country. Owing greatly to the undermanning of the Forest Service, extraction and disposal of produce are chiefly carried on through contractors or middlemen, much to their advantage. It is not only in the case of timber that we lose money, various small industries that many Forest Officers have scarcely heard of, do not contribute the quota that they ought to the profits of the Department; for example, take *the Rosha grass oil industry*. The yearly value of the outturn of this oil is about 7½ lacs of rupees. The sum paid to the owners for the grass is about 6 per cent. of this total; the cost of collection, manufacture, freight to Bombay, etc., comes to about 44 per cent., leaving some 50 per cent. to be divided between the middlemen and the brokers. Why should not the owner by the employment of a suitable establishment have his fair share of this 50 per cent.? Then, again, the method of preparing the oil is by ordinary distillation. If we had officers who were well acquainted with the more advanced methods of distillation, they would point out that by using such the outturn of oil would be perhaps doubled, and thus the revenue that the middlemen or lessees pay would be doubled. We look in vain, however, for officers with a technical knowledge of distillation, while few are to be found with any great commercial instinct or experience as would enable them to take the best advantage of market conditions, and these few would certainly not be available. We suggest another concrete example It is not open to discussion that owing, in large part, to the shortage of establishment, the teak trade in Burma is being chiefly carried out through middlemen. From the latest Burma Administration Report at our disposal we see that the Forest Department sold its teak at Rangoon at an average price of about Rs. 72 per ton (which is considerably below that of past years); moreover, this price is for the teak remaining over after complying with admiralty indents, etc., for which the best timber is reserved. We are probably then on the right side in assuming that the value

all over would generally average Rs. 80 per ton. The same report gives the average royalty paid by middlemen for standing teak at about Rs. 20 per ton. The difference between these two figures, *viz.*, Rs. 60, is the cost of felling and extraction including the salaries and contingent expenses of the staff, purchase and up-keep of elephants, etc., and the profit of the middleman. We do not know what the total cost of extraction per ton works out to, but taking it as high as Rs. 40, this leaves Rs. 20 per ton profit to the middleman or on a total export of 2 lacs of tons, and the average export is generally considerably in excess of 2 lacs of tons, a total profit of 40 lacs of rupees, if not more. This sum is probably well below the mark, as we believe that the average price of teak is now well above Rs. 80, our figure of Rs. 40 per ton for extraction, etc., is perhaps too high. On the other hand, the average royalty may have somewhat increased. In any case the figures are sufficiently accurate to indicate the fact that the annual loss of revenue is very considerable under the present system of working—a loss that no commercial firm would tolerate. We may then say that owing to our unbusiness-like methods the middleman is benefiting to the tune of over 40 lacs of rupees a year at our expense. Doubtless every province can furnish somewhat similar examples, though on a comparatively smaller scale, of our misplaced philanthropy.

In the example cited we would no doubt be met by the argument that there is no staff for departmental extraction and no money available, the former depends on the latter, and to meet the difficulty the question of forest loans already dealt with in our pages will naturally suggest itself.

With money available, a large temporary staff with no special scientific training, and none such appears necessary, under a first class business man who would have to be paid at a high rate and who would probably be well worth the money, could be got together, and if appointments from it to the Imperial or Provincial Service after a course of training in Europe or Dehra Dun, should such be deemed expedient, were from time to time offered to exceptionally promising men, we believe that there would be little difficulty in collecting the staff required.

Such losses of revenue are of great Forest importance, since the more revenue that a Local Government collects, the more willing it is to spend money on sylvicultural operations and on the general improvement of its Forest estate.

Until the Department and those responsible for the education of its recruits realise the fact that, although a knowledge of sylviculture is indispensable and of the cognate sciences generally desirable, such subjects go to make up a portion only of the knowledge that an efficient Forest Officer in India ought to possess: till this is generally accepted, we cannot expect to do full justice to the Forests under our control, and until it is recognized that we, a commercial department, are not working on commercial lines, and that we are not always utilizing the services of our staff to the best advantage, there is no possibility of our collecting the Forest revenues that we have a right to expect, with the result that the development and improvement of our Forest estates are being, and must be, greatly retarded.

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SUPPLY OF TEA BOXES.

It was recognized some two or three years ago that there was considerable difficulty being experienced by planters in Assam and elsewhere in obtaining tea boxes in sufficient numbers to meet their requirements, and that this was reaching a somewhat acute stage. This was due to two causes: in the first place, the supply of timbers suitable for boxes and at a reasonable distance from the saw-mills or tea estates was not so plentiful as heretofore, and secondly, in the event of timber being available, the shooks after being sawn were very subject to insect attack which prevented their being stored and seasoned. It is with this second difficulty that we are chiefly concerned. Mr. Pearson, the Forest Economist, when on tour in Assam some two years ago, proposed to meet this difficulty by treating the shooks so as to preserve them against insect attack. To this objection was made that any such treatment would discolour the wood and probably taste the tea.

Mr. Pearson on his return to Dehra in conjunction with the Forest Chemist experimentally treated some shooks by various methods, and these two officers finally came to the conclusion, that treatment as noted below would probably not taste the tea nor would it discolour the boxes, while it would probably preserve the shooks from insect attack during storage against demand and pending their being made up into boxes, for a certain length of time, at any rate, and also prevent the boxes being attacked in transit.

Accordingly shooks of *Endospermum chinense, Tetrameles nudiflora* and *Bombax malabaricum* were severally treated with weak solutions of either chloride of zinc, alum or sodium flouride and treated specimens sent to the owner of the Surma Valley Saw Mills, others being kept under observation at Dehra Dun. These specimens have now been under observation for more than a year, and there is no sign of insect attack nor discolouration of the wood, while the cost of treatment comes to a few pies per box only. Provided, therefore, tea-planters are satisfied that the treatment does not taste the tea nor injure it in any way, it is up to them to make a practical use of the knowledge placed at their disposal by Mr. Pearson, and to treat or have treated the shooks as advocated by him.

With reference to the question whether the tea packed in treated boxes is damaged in any way, we are enabled to publish the following letter from Mr. T. A. Kerr to Messrs. Duncan, MacNeill & Co., London, forwarded to the Forest Research Institute by Messrs. MacNeill & Co., Calcutta. The samples marked "S" were made of *Bombax malabaricum*, (the common Indian cotton tree), and treated with a 2 per cent. solution of chloride of zinc, the tea being packed in tea-lead with a lining of brown paper, the object of which was to obviate any risk of the tea becoming damaged through the action of the salt with which the shooks were treated on the lead Those marked "T" were similarly treated, and the tea packed in a lining of silverized paper without tea-lead. Mr. Pearson, the Forest Economist at Dehra Dun, will be very pleased to give planters and others any urther information that they may require.

Copy of a letter, dated 4th November 1913, from Mr. T. A. Kerr to Messrs. Duncan, MacNeill & Co., Winchester House, Old Broad Street, London, E. C.

Twenty ½ chests Dewan tea ex "Manora" Experimental shipment.—In reference to the above, being anxious that nothing should be left undone to ensure as satisfactory a trial as possible, I have personally inspected these packages outside and inside, and also the tea, and now beg to report as follows :—

(1) *Ten ½ chests marked "S".*—The wood of these has, in some instances, a little of the smell known in the trade here, as "cheesy." This smell is very slightly discernible on the brown paper, but *not* on the lead and the tea is in excellent condition.

(2) *Ten ½ chests marked "T."*—The wood of these packages is quite free from the smell referred to above, *i.e.*, "cheesy," and the paper too seems free. The tea itself smells drier, and had I not known that it was identical with the tea in the "S" packages, should have described it as being rather more fired.

On liquoring, I find that the tea in the "S" packages compares favourably with that in the "T" packages, being fresher and having retained its character better.

From the trade buyers' view, I should have no hesitation in pronouncing in favour of the "S" packages, with the brown paper and lead lining, my reasons being :—

(1) The tea apparently keeps fresher.

(2) It gives additional security to the tea, in the event of the package being dropped, or roughly handled in transit, which, with the heavy chests now in use, sometimes happens.

(3) The lead being readily saleable, manifestly, the trade prefer packages which have lead lining.

DESTRUCTIVE DISTILLATION OF TIMBER.

Destructive distillation with the object of obtaining a supply of acetones, methyl alcohol, etc., is as yet in its infancy in India. Below we print what purports to be the most recent development of this Industry in America.

WONDERFUL DEVELOPMENT IN WOOD DISTILLATION—THE WHITAKER-PRITCHARD SOLVENT PROCESS (PATENT).

Particulars.

1. The supply of raw material from which the products are made in a practically inexhaustible waste.

2. The amount of yield, by the Whitaker-Pritchard Process, of pure turpentine, light oil, and weightier products is far in excess of any other method—almost, if not quite, two to one, and is also applicable to treatment of oil shale, lignite and coal.

3. The purity of the products is the highest yet attained by any other method of wood distillation. The W.W. turpentine being indistinguishable, by practical painters, as well as by Government chemists, from best "gum" turpentine.

4. The cost of operation is extremely low. The itemized expenses on opposite page being generously "padded." The fuel used to fire the charge is the charcoal left from the previous "run."

5. The market is ready, willing and increasing; and, as more and more uses are found for the "bye-products," the scope widens indefinitely, also applicable to extracting oil from cocoanuts, shells, beans, and other oil-bearing nuts, raisin seeds, etc., etc.

Argument.

The Whitaker-Pritchard Process produces nearly twice the yield from the same weight of waste wood and that with no greater operating expense.

Prospectus

Of a ten-cord wood distilling plant, Whitaker-Pritchard Process.

Capacity of plant.—Twenty tons of wood per day, or ten cords. Cost of plant, including operating fund, $25,000 00 or can be constructed in plants of less capacity to 5, 10 or 15 tons per charge at a proportionately less cost.

OPERATING EXPENSE DAILY—20 TONS OF WOOD PER DAY.

		$
Manager	...	5.00
Superintendent	...	4.00
Book-Keeper	...	2.50
Two men at $2.00	...	4.00
Three men at $1.50	...	4.50
Ten cords of wood at $5.00	...	50.00
Cost of barrels at $1.25 each	...	28.75
Incidental expenses, estimated	...	5.00
6 per cent. interest on $25,000.00 daily	...	4.11
20 per cent. for depreciation, etc.	...	14.00
TOTAL	...	$121.86

INCOME—DAILY.

		$
250 gallons W.W. turpentine, at average of 40 cents.	..	100.00
100 gallons light oil, at 20 cents	...	20.00
1,000 gallons heavy oil, at 15 cents...	...	150.00
100 gallons of pitch at 10 cents	...	10.00
TOTAL	...	280.00

		$
Weekly income, 6 days to week	...	1,680.00
Working expenses, 6 days	...	731.16
Net Weekly income	..	948.84

MARKETING EXPENSE—WEEKLY.

		$
Salesman, at $5.00	...	35.00
Expense of same, at $6.00	...	42.00
Advertising	...	50.00
TOTAL	...	127.00
From net income	...	948.84
Deduct weekly marketing expense	...	127.00
Net Weekly Profit	...	821.84

Estimating a yearly average of 50 weeks, we have an annual profit of $41,092.00 applicable to dividends on $50,000.00 common stock.

A NOTE ON *OXYRHACHYS TARUNDUS* FABR.

DISTRIBUTION.

Bengal, Calcutta, Pusa, Madras, Chatrapur, Ganganu, Mysore, Bangalore, Karachi, United Provinces, Dehra Dun, Abyssinia, Egypt, Senegal, South Africa.

FOOD-PLANTS.

On *Acacia siamea, Acacia arabica* and *Casuarina* sp. reported from Madras. On *Cassia Fistula, Acacia arabica* reported from Bihar (Pusa). On *Acacia Catechu, Albizzia Lebbek, Albizzia procera, Phyllanthus Emblica, Tamarindus indica* and *Dalbergia latifolia* reported from Dehra Dun District.

INTRODUCTION.

This insect is a member of the family MEMBRACIDÆ of the group HOMOPTERA-HEMIPTERA, Order RHYNCHOTA. It is one of the common species of bugs frequenting vegetation and attracts attention on account of its triangular shape, its habit of sitting gregariously on the tender stems of the food plant with its proboscis inserted in it sucking plant sap, its rather sluggish movement but possessing great vaulting powers when disturbed, and being assiduously attended by ants. In December 1911 this insect was noticed in the Forest Sylviculturist's experimental garden, attached to the Research Institute, and was reported as doing damage to *Albizzia Lebbek* saplings. Again, in September 1912, it was reported to be the cause of much damage to young *Albizzia procera* trees by the Sylviculturist. Since its first report I have had the opportunity of observing the doings of the insect on *Albizzia Lebbek, Albizzia procera, Acacia Catechu* and *Phyllanthus Emblica* trees.

CAUSE AND NATURE OF INJURY.

The insertion of the proboscis of the insect in the tender stems of food-plants to suck sap is no doubt detrimental to the growth of the stems to some extent, but the greater amount of injury is due solely to the incisions made on the tender shoots

by the female *Oxyrhachys* with her saw-like ovipositor (Plate III, fig. 8) while in the act of laying her eggs. The tender branches of *Albizzia Lebbek*, *Albizzia procera*, *Acacia Catechu*, are often completely scarificed on account of the cuts made by the female during oviposition and the result is that the trees become stunted, bark bound and make a bushy growth. Subsequently the so-weakened condition of the tree makes it more exposed to the attacks of other wood-feeding insects. Examination of *Albizzia*, *Acacia*, and *Phyllanthus* twigs has shown that the old scars from egg punctures of *Oxyrhachys tarandus*, furnished favourable conditions for the attacks of a lepidopterous insect, which deposits its eggs in the deceased spots left by the *Oxyrhachys*. The larva on hatching penetrates the wood and burrows up and down the twig which consequently assumes a swollen or knotted appearance.

EGGS.

Eggs are laid by the insect in the bark of young shoots of food-plants. The incisions made by the insect in the bark to oviposit are in rows arranged in a V-shaped manner (Plate III, figs. 1 and 2). The eggs are laid in the incisions with one end exposed. The egg when freshly laid is cylindrical, slightly curved, with one of its ends broader than the other. From the end which is under the bark a fine curved process (the function of which is not known) is seen to be directed towards the wood. Apparently this spine serves to fix the egg in its position in the plant. The egg (Plate III, fig. 3) measures 1.44—1.5 m.m. in length. It is whitish in colour when freshly laid, but in course of a few days the exposed end becomes pinkish and subsequently a black spot is seen in the middle of the exposed end. The eggs are placed in the plant in small compound groups of rows, each row measuring from 2—5 m.m. containing from 4—13 eggs, separated by slightly more than 1 m.m. of bark. A compound group may contain from 100—250 eggs.

LARVA AND NYMPH.

The young larvæ and nymphs are found gregariously with the adults. They are brown or chestnut in colour. The abdomen

EXPLANATION OF PLATE III.

Fig. 1. Eggs laid in twig of *Albizzia Lebbek* (natural size).

2. Eggs laid in twig of *A. Lebbek* × 6

3. Eggs freshly laid (left), before hatching (right) × 30.

4. *Oxyrhachys tarundus*, Fab., ♀ × 6.

5. Front view of head of adult × 6.

6. Terminal segments of female abdomen, ventral view × 25.

7. Terminal segments of male abdomen, ventral view × 25.

8. Side view of female abdomen showing a sheath of *b* ovipositor × 10.

9. Antenna × 103.

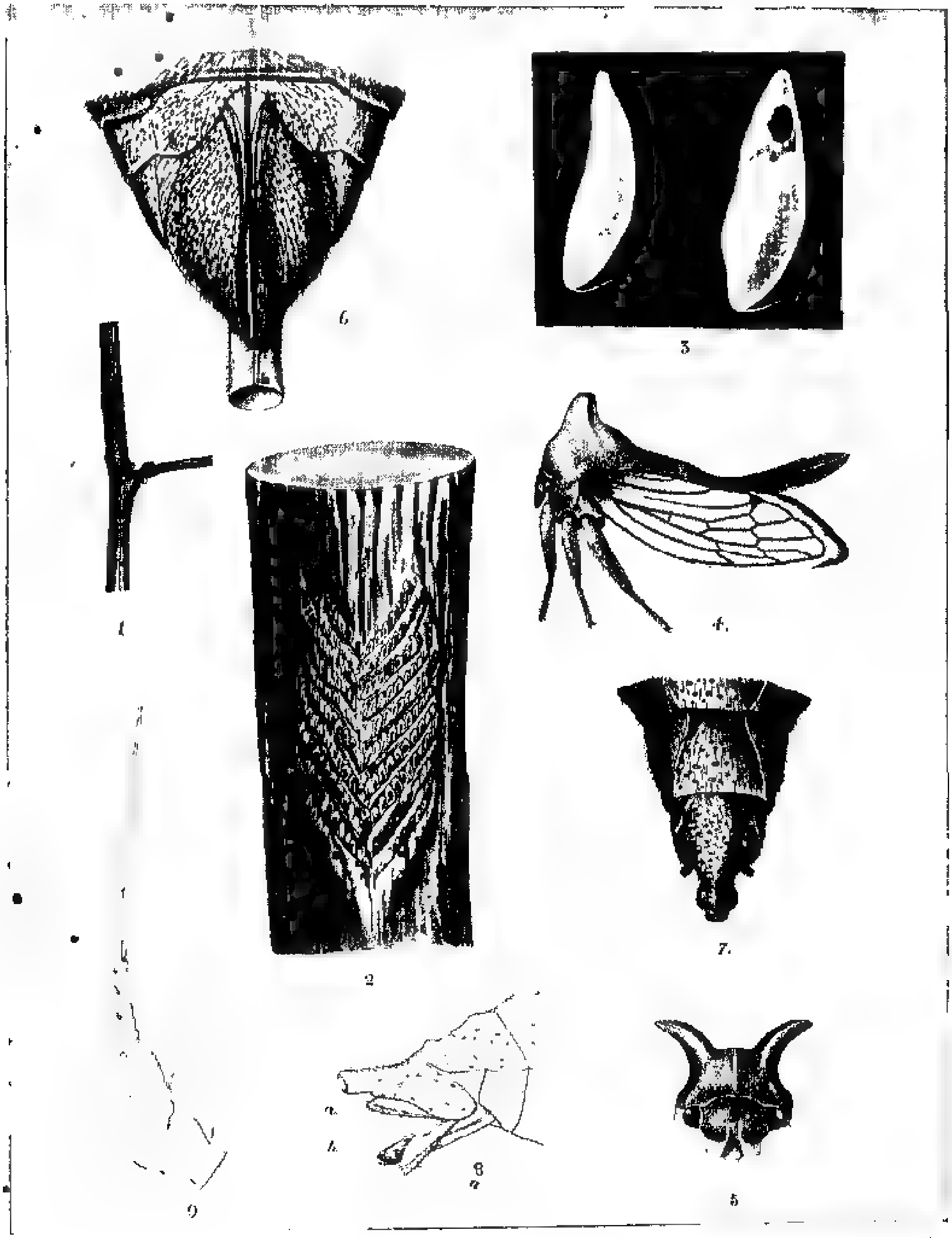

Photo. Mech. Dept., Thomason College, Roorkee. J. S. Singh, *del.*

Oxyrhachys tarandus, Fab.

terminates in a telescopic tube to which is fitted an extensile organ of crimson colour from which a sweet fluid is emitted.

This sweet exudation is much coveted by ants. I have frequently watched the larvæ and nymphs of *Oxyrhachys* being assiduously attended by ants. When the insect is undisturbed this extensile organ is withdrawn into the telescopic tube, but is extruded immediately upon receiving a slight jerk from the front legs of the attendant ant. They pass through five moults probably less before reaching the adult stage. In general characteristics they resemble the adults, but are wingless, without posterior pronotal process, and smaller in size.

ADULT.*

(Plate III, figs. 4 and 5) Ferruginous or fuscous, thickly punctate, head frontally piceous, often apically more or less marginally ochraceous, tegmina dull hyaline, the veins fuscous, the base narrowly pale ferruginous, pronotum with a central longitudinal carination, which traverses the length of the posterior process. The lateral process sub-horizontal, seen from behind a little recurved, seen from the front more upwardly recurved, strongly tricarinate, compressed, their apices obtusely acute, posterior process long, extending beyond tegminal apices, upwardly recurved, beneath laminately ampliate and finely serrate, legs somewhat longly pilose. Length 7—9 m.m., breadth of the lateral pronotal process 4 m.m. The males are usually smaller in size than the females, and there is a great difference in the structural details of the last three male and female abdominal segments (Plate III, figs. 6 and 7).

LIFE-HISTORY.

Very little definite is known about the length of the life cycle of this insect. The development from the laying of the eggs to the hatching of the larvæ occupies some weeks and another few weeks are taken by the young in passing through the moults. I have seen the insect breeding almost at all times of the year, and so no particular season can be at present laid down. In one case the adults made their appearance in the last week of July and

* W. L. Distant "Fauna of British India, Rhynchota," Vol. IV, p. 4.

became most plentiful in August and September. They started ovipositing from about the middle of August and continued doing so up till the middle of October. The last female I saw ovipositing was on the 13th of October Possibly the insect has more than one generation. The number of broods and the length of each cycle is under observation in the Research Institute Insectary.

HABITS.

The adult female lays its eggs as described above readily on new shoots of old trees, as well as on those of young trees, but the effect of their attack is most evidenced on trees which are of two or three years' growth. Generally the insect makes incisions to deposit its eggs on the upper and lateral surfaces of the twigs. The cuts are made in such a manner that a small portion of bark is always left between two incisions. This small portion of intervening bark which is cut loose by the insect with its ovipositor serves to further the aims of the insect in more than one way. Firstly, it helps to deaden that portion of the wood which lies between two adjacent rows of eggs, and secondly, it serves to protect the eggs from being crushed by the rapid growth of the twig under the now new conditions. The subsequent result of all these is that a large scar is produced which with the growth of the twig under the new conditions enlarges and after a period of time assumes an oval form, the adhering dead bark meanwhile breaks out (Plate IV). This has been more noticeable in cases of *Albizzia Lebbek* and *Albizzia procera* trees than in *Acacia Catechu* and *Phyllanthus Emblica.*

REMEDY.

Until the life-history of this insect is worked out, no proper measures can be satisfactorily laid down, but in individual cases of trees attacked and in small nurseries and gardens where the insect is more abundant the following may be adopted :—

(1) Spraying with kerosine and soap emulsion.
(2) Keeping the ground between two trees clean and constantly ploughed.
(3) Hand-picking, collecting the larvæ nymphs and adults in a basket and destroying them.

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by T. B. Chitrakar.

Oxyrhachys tarundus, Fab.

A twig from a three-year old Albizzia Lebbek tree showing (*a*) an old scar, (*b*) dead terminal shoot.

Furthermore, Nature to keep her balance in equilibrium helps a good deal to keep the insect in check. The eggs of *Oxyrhachys tarundus*, Fabr., have been found to be parasitised by a minute hymenopterous fly of the family *Chalcidæ*.

In conclusion, it is very interesting to see the habits of our *Oxyrhachys* to be, if not quite identical, nearly parallel to those of *Ceresa bubalus*, Fab., described by Mr. C. L. Marlatt of the United States Department of Agriculture in Circular No. 23 Second Series, in the year 1897.

N. C. CHATTERJEE, B.Sc.

EXTRACTS.

PREVENTION OF THE GROWTH OF SUCKERS FROM STUMPS.

This is another of those questions which have been frequently answered by us, says the *Queensland Agricultural Journal.*

The best way to effect the destruction of suckers or to prevent their growing is, if the trees are to be ringbarked, to ringbark in a different fashion to the usual method of cutting out a ring of bark and sapwood. Cut straight in for the upper part of the ring, but cut down slantwise at the bottom part, leaving the bark standing up like a fringe, removing, of course, the detached ring of bark. Then with an oilcan or teapot, pour behind this fringe a small quantity of "Peardoom." Or make a mixture of 1 lb. white arsenic, 1¼ lb. soda crystals, ½ lb. saltpetre, 1 gallon water, diluted to double the quantity, if necessary. This mixture will destroy not only the trees but the roots, and consequently no suckers will appear.—[*Tropical Agriculturist.*]

PRESERVATION OF TIMBER.

Douglas fir has an average of five years life when untreated; treated, it lasts twelve years. Hemlock, lasting as a natural wood five years, doubles its term of life when treated, as does tamarack Spruce is one of the species which when untreated decays most quickly, lasting only three years. If treated it will last twelve years, its life being thus increased 300 per cent. To sum up, wood preservation not only prolongs the life of durable timbers, thus decreasing their annual consumption, but also permits the substitution of inferior species, whose use considerably reduces the drain upon the more desirable kinds.—[*Canadian Forestry Journal.*]

SAWDUST BRIQUETTES.

A new industry may be successfully combined with the planing mills—that of making of the sawdust briquettes to be used for firing under the boilers, thus considerably decreasing the cost of the fuel to the mill owner. According to a note in a recent issue of the *Scientific American*, this is being very advantageously done in Germany. The sawdust is automatically gathered and conveyed to a place near the presses. From here it is carried over a heated belt-conveyor to a drying-room. This is a cylindrical revolving drum about two feet in diameter and twenty feet long. In this drum the sawdust is partially dried, the pitch contained in the wood is softened, acting hereafter as a binder. From here the sawdust is conveyed over an incline to the after-dryer of the same shape as the first dryer, which forms a part of the press. Here it is submitted to a higher temperature to drive off all the moisture, and kept running forward toward the end of the after dryer by rotating paddles. At the end of this after-dryer, the sawdust falls through an opening into the trough of the press.

At the end of each pressing operation, which takes place about twenty-four times a minute, a briquette is made about 5⅝ inches by 2⅝ inches by 1⅝ inch, weighing between one half and three-quarters of a pound. From the press briquettes are carried by another belt-conveyor to a cooling-room, and are then ready for use.—[*Paper Inc. in the Canadian Forestry Journal.*]

INFLUENCE OF THE PARENT TREE ON THE PROGENY

In the third Part of Volume X of the "Mitteilungen der Schweizerischen Centralanstalt für das forstliche Versuchswesen," Professor Engler, the Director of Swiss Forestry investigations, sets out in detail the results of his work on the influence of the origin (provenance) of seed on the character of the resulting plants. The part is illustrated with figures of plants and with graphic drawings, and is well worth detailed study by those who take a serious interest in the subject. For the general reader of

the Journal, however, it may suffice to summarise the principal results as follows :—

1. One and two-year-old Scots pine seedlings raised in various nurseries between elevations of 1,400 and 3,800 feet show a height in inverse proportion to the altitude above the sea of the place where the mother-trees furnishing the seeds grew; that is to say, seed from the highest altitude produced the smallest plants, and *vice versâ*. Seed obtained from Scandinavia produced the smallest plants when obtained from the highest altitude; whereas urther south in Scandinavia the situation of growth of the parent trees the taller were the resulting seedlings.

2. *In the first year* of their life, it was not till late summer or autumn that pine seedlings completed their growth, though Scandinavian and East Prussian varieties ceased to grow from one to two months earlier than the seedlings from the low ground of Switzerland and Germany. In the *second year* of their life, on the other hand, all pine seedlings ceased to grow in height about the end of May or beginning of June, no matter what the source of the seed may have been.

3. In nurseries situated at low levels in Switzerland, the largest and finest pine plants were raised from seed obtained from East Prussia, North Switzerland, Scotland and East Russia, followed by seedlings raised from French and South Scandinavian seed. Plants raised from seed obtained from south-west Germany were found to grow quickly, but suffered greatly from snow.

4. When badly-formed mother trees, that is to say, trees with gnarled and twisted boles, were selected for producing seed, the plants resulting from the use of such seed proved to be for the most part poor in character. This, however, was found to be the case only when the defects of the parent trees were due to poverty or aridness of the soil, if, on the other hand, the defective form of the mother trees was due to gales or to injury by man or animals, the plants resulting from the use of such seed were normal in character.

5. As regards susceptibility to the fungus causing leaf-shedding (*Lophodermium pinastri*), it was found that the best seedlings

were got from Scandinavian and East Prussian pines, whereas plants most susceptible to this disease were raised from Alpine pines, no matter at what altitude the parent trees had grown.

6. In autumn or winter the leaves of young pines in Switzerland generally take on a yellowish or brownish colour, such discolouration being most marked in the case of plants raised from East Prussian and Scandinavian seed, and least so in the case of seedlings raised from French, Belgian, and Scottish trees. That the yellow or brown colour is intimately associated with cold, dry weather in winter seems to have been proved by the fact that trees so discoloured could be restored to a normal green appearance by placing them for ten to fourteen days in a conservatory.

Professor Engler has much to say on the subject of the inheritance of acquired characters, a question that has long interested students of heredity. His experiments show that defective form of the Scots pine due to soil is transmitted to the first generation, but whether this is the case of heredity, or of modification due to environment (Nachwirkung), he does not feel justified in deciding. The fact remains, however—and on this he places great weight—that physiological properties induced in the tree by the soil are transmitted to the progeny through the germ cells.

Professor Engler's experimental ground on the Adlisberg, near Zurich, was visited by the Roy. Scot. Arb. Soc in July last.—[*Quarterly Journal of Forestry*.]

CIRCULAR SAWS OF PAPER.

Paper is at present used for all possible purposes in the industries and in all possible forms. It has even been possible by means of compression to give it a degree of hardness comparable with stone, so that it can be used as building material. The latest use for paper, however, is perhaps the most peculiar. According to a European Journal, a factory is said to exist in England which is manufacturing circular saws from paper. These paper-saws are used for the manufacturing of fine furniture, veneer and other thin

plates of wood, which must be treated especially carefully. Some time ago circular saws made from drawing paper were shown in an English exposition. The saws were driven by an electric motor and produced fine boards, which could not have been made better even by the finest steel saw.

The veneers made in this way are so smooth that the cabinet-makers can use them without further planing.—[*Scientific American.*]

BIRDS THAT SHINE

Luminous birds seem to have attracted attention from the time of Pliny, but they have eluded close acquaintance about as successfully as the modern sea-serpent. Some familiarity with them was gained, however, as long ago as 1641, when phosphorescent fowls were marketed, including a brilliantly glowing cock and hen from different parts of France. In 1907, Sir Digby Piggott called the attention of naturalists to luminous birds in England, and early in the year one of a pair seen in Norfolk was killed by a game-keeper, and identified as a common barn-owl (*Strix flammea*). The light was compared to that of a bicycle lamp 300 or 400 yards distant, its rapid diminution as the bird turned away from the observer suggesting that the luminosity was confined to the breast. An account by Count L. de Sibour states that the theory accepted at first was that the phosphorescent bacteria of decaying wood had become attached to the feathers, but a later and preferred view is that the dampness and uncleanliness of the breast covering favors a sudden growth of shining bacteria peculiar to feathers.—[*Capital.*]

A NEW SPECIES OF EUONYMUS.

There are about 70 species of *Euonymus* known, and the genus is particularly well represented in the mountains of India, some of them ascending to over 12,000 feet in the Himalayas. It is, however, rare to find the genus represented in the plains, and the one now figured and described is, it is believed, the first record of any representative from the Central Provinces of India. In the Southern India mountains and the Ceylon mountains there are several species, *viz.*, *revolutus*, *crenulatus*, *Thwaitesii* and *Walkeri*, all more or less allied to one another, and it is to this circle of alliance that the species now described belongs.

E. godaverensis is a member of an interesting botanical formation occurring in the extreme south of the Chanda district, in the tract of land lying between the Godaveri and Indravarti rivers in the Sironcha tahsil. Along the numerous nalas and smaller rivers of this tract, which apparently overflow their banks in the rainy season but become dessicated in the cold and hot seasons, is a sandy alluvium which supports a poor forest composed of small trees with mostly evergreen entire leaves recalling to some extent the scleropnyllous flora of the Mediterranean. In most of the species present the leaves are small. Among the more important of these species of trees and shrubs are *Mimusops hexandra*, *Memecylon edule*, *Erythroxylon monogynum* (deciduous), *Buchanania angustifolia*, *Canthium didymum*, *Gelonium lanceolatum*, *Atalantia monophylla*, *Ixora parviflora* and the *Euonymus godaverensis*.

The wood of this *Euonymus* is said to be ground up and rubbed on the body like Sandal, but it seems to the writer to have absolutely no smell.

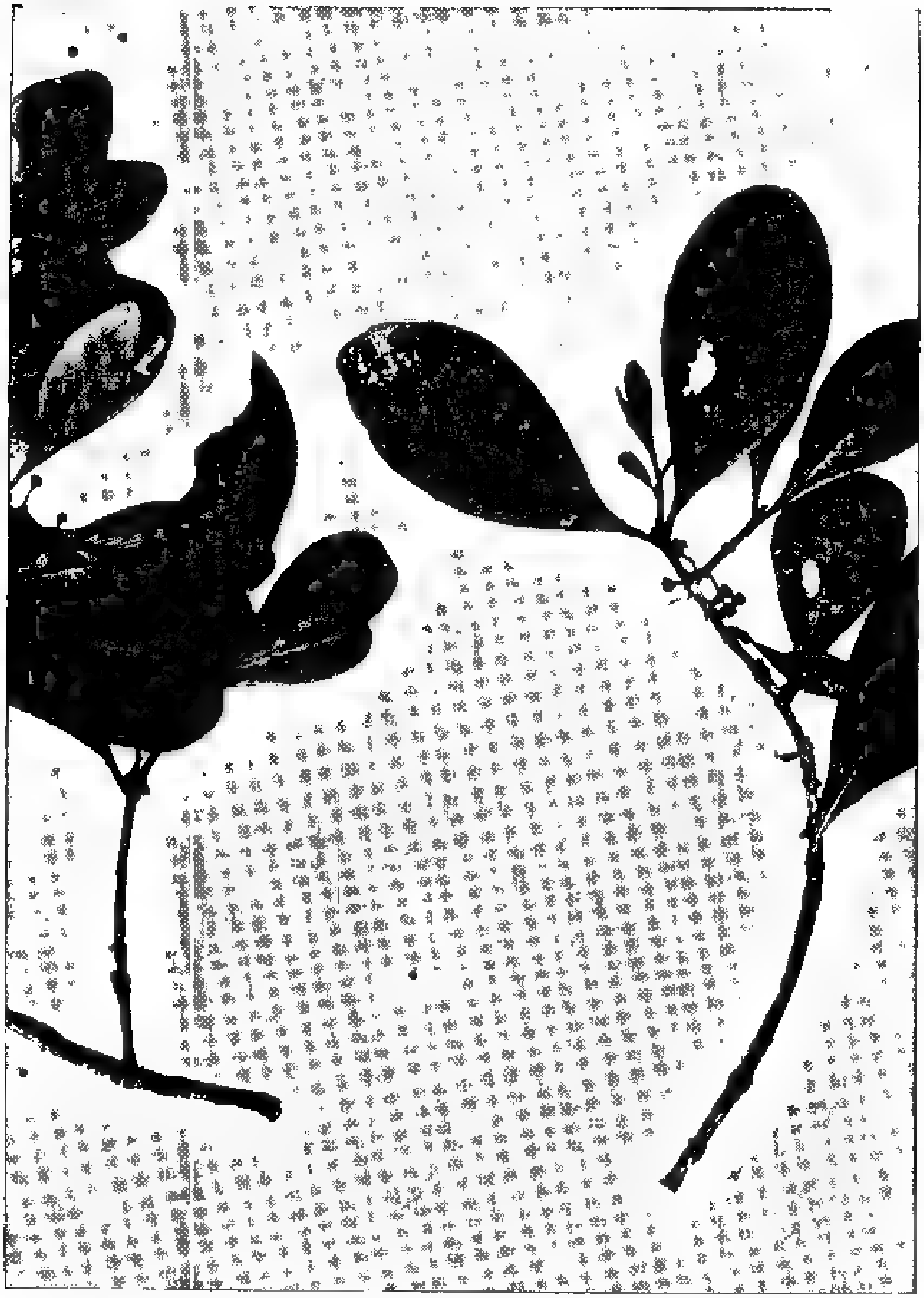

Photo.-Mechl Dept. Thomason College, Roorkee.

EUONYMUS GODAVERENSIS
FLOWERING SHOOT

(*Natural size*).

Sandalwood—						
Chips ...	London ...	Quotations not available				
Billets ...	" ...					
Saw-dust ...	" ...					
Satinwood ...	" ...					
Senna (Tinnevelly) .	" ...	†1½d. to 8½d.	lb.	*1½d. to 8½d.	lb.	
Shellac, T.N. in Diamond	Calcutta ...	Rs. 24 to Rs. 26	md.	Rs. 22-2-8 to Rs. 23-8	md.	
" T.N. " "	London ...	††55s. to 57s.	cwt	**54s. 10d. to 61s. 4d.	cwt.	
" A.C. in Garnet	" ...	††59s. 6d.	"	**60s. 10d.	"	
" T.N. Orange ...	" ...					
Skins—						
Sambhar ...	London ...	Quotation not received.				
Chital ...	" ...					
Leopard ...	" ...					
Sleeper, Chir—						
" 12′	Jagadhri ...	Rs. 48 to Rs. 50	score	Rs. 46-5-4 to Rs. 52-5-4	score.	
" 11′	" ...	Rs. 40 to Rs. 46	"	Rs. 40-10-8 to Rs. 48	"	
" 8′	" ...	Rs. 24 to Rs. 30	"	Rs. 24-5-4 to Rs. 31-5-4	"	
Tamarinds—						
Madras ...	London .	†6s. to 10s.	cwt.	*6s. to 10s.	cwt.	
Calcutta ...	" ...	†14s. to 15s.	"	*14s. to 15s.	"	
Indian ...	Calcutta ...	Rs 2 4 to Rs. 6	md.	Rs. 2-5 4 to Rs. 6-4	md.	According to grades.
Teak (selected Indian, 1st quality).	" ..	Rs 170 to Rs. 185	ton.	Rs. 170 to Rs. 183-5-4	ton	Ton = 50 c.ft.
Turpentine—						
" American Spirit spot	London ...	††Re. 1-12-2 to Re. 1-14-1	gal.	**Re. 1-13-2 to Re. 1-15-8	gal.	
" Weight Brand ...	Calcutta ...	Re. 1-7 to Re. 1-10	"	Re. 1-8-4 to Re. 1-10-8	"	
" Hand Brand ...	" ...	Not quoted.	"		"	
" Hubbuck's genuine...	" ...	Rs. 3-12 to Rs. 4-4	"	Rs. 3-6-8 to Rs. 3-13-4	"	
" Blundell Spence & Co.	Bombay ...	Not quoted.				
Wilkinson, Heywood & Clerk	" ...					
Standard Oil Co. ...	" .	Rs 2-6-7	gal.	Rs. 2-7-2 to Rs. 2-9-2	gal.	

Note.—† Rates for September 1914.
* Average rates for period July 1914 to September 1914.
†† Rates for October 1914.
** Average rates for period August 1914 to October 1914. Md. indicates Bengal maund, which is equal to 82 lbs.
All prices shown in column 3, represent the highest and lowest prices recorded up to the 25th November 1914.
All prices shown in column 5, represent the average rates for three months' prices, recorded up to the 25th November 1914.
All prices, not cross marked in the third column, represent the market rates for November 1914.

DEHRA DUN, U. P.:
Dated 1st December 1914.

R. S. PEARSON,
Forest Economist

LIST OF BOOKS AND PUBLICATIONS RECEIVED BY THE HONORARY EDITOR, DURING THE MONTH OF OCTOBER 1914.

India Rubber World, dated 1st September 1914.

The Scottish Geographical Magazine, Vol. XXX, No. 9, for September 1914.

Commercial America, Vol. XI, No. 3, for September 1914.

Report of the Director of Forestry for the year 1913.—*Department of the Interior Canada.*

Indian Engineering, Vol. LVI, Nos. 14, 15, 16 and 17, dated 3rd, 10th, 17th and 24th October 1914.

Indian Forest Insects, by E. P. Stebbing, I.F S.

Studies of an Acid Soil in Assam. *Memoirs of the Department of Agriculture in India—Chemical Series*, Vol. III, No. 9.

The Journal of the Board of Agriculture, Vol. XXI, No. 6, for September 1914.

The Review of Applied Entomology:—Series A: Agriculture, Vol II, Part 8, for August 1914.

The Review of Applied Entomology:—Series B: Medical and Veterinary, Vol. II, Part 8, for August 1914.

Title-page and Index to the Review of Applied Entomology, Vol. I, Series A: Agricultural.

Progress Report of Forest Administration of Jodhpur State, Rajputana, for 1912-13.

Progress Report of Forest Administration of the Province of Bihar and Orissa for 1913-14.

The Indian and Eastern Engineer for October 1914.

Classified List of Forest Officers in India and Burma for July 1914.

The Forest Flora of New South Wales, Vol. VI, Part 4, by J. H. Maiden.

Some General Methods of Controlling Attacks by the Insect Pests, Leaflets Nos. III and IV of 1914, *Department of Agriculture, Madras.*

Department of Agriculture, Bombay.—Bulletins Nos. 56, 57, 58 and 59 of 1913.

Forestry Quarterly, Vol. XII, No. 3.

Land Records Administration Report of Burma for the year ended 30th June 1914

Punjab Forest Administration Report for 1913-14.

The Quarterly Agricultural Journal of India, Vol. IX, Part IV, for October 1914.

Printed at the Pioneer Press, by GEO. SIM, No. 1569. 15 12-14.

DESCRIPTION.

Euonymus godaverensis, *n. sp.* Vern. Ali Chetu, Nakiragudam Chetu, *Telegu.*

Frutex magnus vel arbuscula 3·5—6 m. (12—20 ped.) alta et 100 cm. (3·5 ped.) ambitu pervenens, ramis erectis, ramulis jugis quatuor prominentibus e stipularum basibus decurrentibus instructis. Stipulæ minutæ. Folia opposita, raro subopposita lanceolata, elliptica vel leviter ovato-lanceolata, apice obtusa v. rotundata, base attenuato-cuneata, 4·5—8 cm. longa (1·7—3·25 poll.) et 2·5—4 cm. vel 5 cm. (1—1·5 v. 2 poll.) lata, coriacea, glabra, subtus leviter pallida, margine integerrima leviter recurvato vix revoluto, nervis lateralibus tenuissimis obscuris circa 5—6 utrinque mox reticulatis. Petiolus 2·5 mm.—3·5 mm. (·1—·15 poll.) longus. Cymæ 3-floræ, rarissime 1-floræ, virgarum novarum base positæ. Pedunculi 5 mm. (·2 poll.) longitudine haud attingentes. Bracteæ bracteolæque minimæ, ovatæ, dentatæ. Flores inter affines minimi, 2·5 mm. (·1 poll.) diametro, pallide-virides. Sepala 5, orbiculata. Petala 5—6, late oblonga, apice rotundata, integerrima, margine sub-hyalina. Stamina 5. Discus leviter 10-corrugatus. Ovarium 3—1 loculare. Stigma capitatum.

Florens Dec.—Jan. Sempervirens.

In campis (non in montibus) Peninsulæ Indiæ, in districtu Chanda, fluminum Godaverensis Indravartensisque regione, secundus rivulorum alveos arenaceos. Haines No. 111, C.P.

E. revoluto, *Wight,* E. crenulato, *Wall.* E. Walkeri, *Wight* arcte affinis.

Ab E. revoluto pedunculis brevissimis, floribus parvulis, petalorum colore formaque et foliorum marginibus leviter revolutis distinguitur.

Ab E. crenulato pedunculis brevissimis, floribus parvulis, ramulis 4-gonis, foliorum venulis tenuibus marginibusque minus revolutis distinguitur.

Ab E. Walkeri foliis integerrimis, venulis magis obliquis petalorum forma margineque et foliorum siccatorum colore recedit. Prætereaque haec tres species omnes montium incolæ sunt.

The bark is rugose, the blaze grey and dark crimson, the wood white.

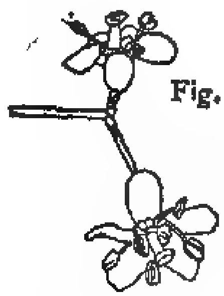

Fig. A.

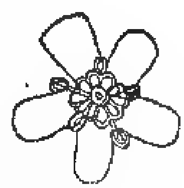

Fig. B.

Fig A., a cyme. Fig B., a flower enlarged about 8 diameters; the lobing of the disc is a little exaggerated.

See also Plates V and VI.

H. H. HAINES, I.F.S.

30th November 1913.

A FURTHER NOTE ON CALORIMETRIC TESTS OF SOME INDIAN WOODS FROM BELGAUM (BOMBAY).

BY PURAN SINGH, F.C.S.,

Chemical Adviser to the Forest Research Institute, Dehra Dun.

Some time ago, twenty-five samples of different woods and one of charcoal made of mixed woods in closed kiln, were received from the Divisional Forest Officer, Belgaum, Bombay, for the determination of their calorific value and for an expression of opinion as to their value for charcoal-making. The tests were made just as given in my "Note on Calorimetric Tests of Some Indian Woods." *Forest Bulletin No.* 1, 1911, with the following results :—

Photo.-Mechl Dept. Thomason College, Roorkee.

EUONYMUS GODAVERENSIS
FLOWERLESS SHOOT.

(Natural size).

Table of Calorific power of some Indian woods from Belgaum, Bombay.

Number.	Name of species.	Air-dry.		Calorific power (for completely dried materials).			Remarks.
		Moisture per cent.	Ash per cent	Calories.	B. T. U.	Evaporative power.	
1	*Acacia arabica* ...	8·32	2·56	3,960	7,128	7·38	
2	*Albizzia Lebbek* ...	10·15	5·27	4,591	8,264	8·56	
3	,, *procera* ...	10·27	2·60	4,657	8,383	8·68	
4	*Anogeissus latifolia*, large log, top girth 15″ and bottom girth 20·7″.	11·26	2·88	4,214	7,585	7·85	
5	*Anogeissus latifolia*, small log.	11·22	4·24	4,212	7,584	7·80	
6	*Careya arborea* ...	10·20	3·67	4,288	7,718	7·99	
7	*Casallia integerrima* ...	10·77	11·54	3,697	6,655	6·89	
8	*Cassia Fistula* ..	10·01	2·11	4,400	7,920	8·20	
9	*Dillenia pentagyna* ...	11·32	3·94	4,956	8,921	9·24	
10	*Diospyros montana* ...	9·83	2·97	4,879	8,798	9·11	
11	*Eugenia Jambolana* ...	11·28	1·92	4,712	8,483	8·78	
12	*Ficus Rumphii* ...	11·71	5·00	4,236	7,625	7·89	
13	,, *Tjakela* ..	10·91	3·78	4,321	7,778	8·05	
14	*Grewia tiliaefolia* ..	10·52	1·41	4,424	7,963	8·24	
15	*Gmelina arborea* ...	9·79	5·20	4,268	7,682	7·95	
16	*Hardwickia binata* ..	11·37	2·10	4,716	8,489	8·79	
17	*Lagerstraemia microcarpa* ..	10·20	2·98	4,288	7,718	7·99	
18	*Mangifera indica* ...	10·20	9·52	3,797	6,835	7·08	
19	*Pongamia glabra* ...	11·10	3·32	3,922	7,060	7·31	
20	*Phyllanthus Emblica* ...	12·13	2·60	4,508	8,114	8·42	
21	*Randia dumetorum* ...	10·63	2·06	4,678	8,317	8·67	

Table of Calorific power of some Indian woods from Belgaum, Bombay—(concld.)

Number.	Name of species.	Air-dry. Moisture per cent	Air-dry. Ash per cent.	Calorific power (for completely dried materials). Calories	B. T. U	Evaporative power.	Remarks
22	*Stephegyne parvifolia* ...	11·45	1·98	4,720	8,496	8·79	
23	*Sterculia guttata* ...	10·28	2·56	4,721	8,498	8·80	
24	*Terminalia Chebula* ..	10·34	7·28	3,935	7,083	7·33	
25	" *paniculata* ..	11·75	5·02	4,425	7,965	8·24	
1	Mixed charcoal from a closed kiln made of – (1) *Terminalia belerica.* (2) *Lagerstræmia microcarpa* 3) *Ficus Rumphii* 4) *Gnetum scandens.* 5) Ranbibta or Bhaloli 6) *Olea dioica* 7) *Cinnamomum zeylanicum*	6·05	5·41	5,502	9,903	10·25	

It will be seen from the above table that the calorific value of all these different woods varies from 3,697 calories to 4,969. The ash content varies from 1·41 to 11·54 per cent. The woods with ash content higher than 5 per cent. may be considered inferior for charcoal-making.

Of these woods, therefore, the Nos. 7, 18 and 23 may be put as inferior woods for charcoal, while others are of average quality.

The charcoal is low in its calorific value.

REGULATIONS FOR APPOINTMENT OF PROBATIONERS TO INDIAN FOREST SERVICE.

The following Regulations for the selection and training of probationers for the Indian Forest Service are published :—

INDIAN FOREST SERVICE.

Regulations as to the Appointment of Probationers, 1914.

1. *Appointments.*—The Secretary of State for India in Council will, in the summer of 1914, make not less than five appointments of Probationers for the Indian Forest Service, provided that so many candidates are considered to be in all respects qualified.

In making these appointments, he will act with the advice of a Selection Committee.

2. *Applications for Appointment.*—Applications for appointment must be made on a printed form to be obtained from the Secretary, Revenue Department, India Office, Whitehall, London, S. W., and to be returned to him not later than Wednesday the 1st July 1914. Candidates must be prepared, if called upon, to attend at the India Office, at their own expense, for a personal interview with the Selection Committee within three weeks from that date.

3 *Age Limit.*—Candidates must be not less than 19 but under 22 years of age on the 1st January 1914.

NOTE.—For the year 1914 only, candidates who have taken an honours coruse (or other course specified in paragraph 5).which, under the Regulations of the University, occupies four years, will be subject to the age limits which have hitherto been in force, viz., 19 and 23 on the 1st July of the year in which selection is made.

4. *Nationality, etc.*—Every candidate must be a natural-born subject of His Majesty. He must be prepared to give an undertaking, if selected, that he will not marry before he reaches India. If he does so, he will forfeit his appointment. He must be of good physique, and must produce evidence of character to satisfy the Secretary of State for India in Council that he is suited for the Indian Forest Service.

5. *Qualifications.*—Candidates must have obtained a degree *with Honours* in some branch of Natural Science* in a University of England, Wales, or Ireland, or have passed the Final Bachelor of Science Examination in Pure Science in one of the Universities of Scotland. † A degree in Applied Science will not be considered as fulfilling these conditions. Candidates will be required to produce evidence that they have a fair knowledge of either German or French.

Note.—Applications for appointment will be accepted from candidates who on the 1st July 1914 have already sat at an examination for a degree as mentioned above, but have not learned the result of the examination.

6. Should there be more candidates considered to be qualified in every respect than vacancies to be filled, the Secretary of State reserves the right to require them to pass a competitive examination conducted by the Civil Service Commissioners, on the results of which their final selection would depend. Particulars of this examination, which would be held in August, will be found in Appendix I.

7. *Medical Examination.*—Selected candidates will be required to undergo a strict examination by a Medical Board at the India Office, at which particular stress will be laid on good vision and hearing, and to satisfy the Secretary of State for India that they are physically fit for service in the Indian Forest Department (*see* Appendix VI).

Candidates who do not satisfy the Secretary of State for India that they are physically fit for appointment to the Indian Forest Service will not be admitted to the competitive examination mentioned in Regulation 6.

8. *Period of Probation.*—Before appointment to the Indian Forest Department, a probationer will be required—

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* A Moderatorship in Natural Science or in Experimental Science at the University of Dublin will be considered as fulfilling these conditions.

† Graduates in Forestry at the University of Edinburgh are regarded as satisfying the requirements of this paragraph if they pass the Final Examination of that University in some one branch of Natural Science embraced in the degree in Pure Science.

(i) to have obtained, either before selection as probationer, or within the period of two years' probation, the degree or diploma in Forestry at one of the Universities named in the margin*;

* Cambridge, Oxford, or Edinburgh.

(ii) to have undergone a special course of instruction in Forestry, under the direction and supervision of the Director of Indian Forest Studies appointed by the Secretary of State for India in Council, in such British and Continental localities as may be selected for the purpose;

(iii) to have passed an examination in certain special subjects, namely, Systematic Botany of Indian trees, Indian Geology, Forest Law, Indian Working-plans, and, if required, an Indian vernacular language;

(iv) to have undergone a final competitive examination in Forestry (*see* Appendix II);

(v) to have satisfied the Secretary of State, in such manner as may be determined, of his ability to ride.

The period of probation will in ordinary cases be two years. The Director of Indian Forest Studies will instruct probationers in each case as to the order and manner in which they should fulfil these various requirements.

9. *Charges.*—The probationers will be required to defray all expenses of lodging, board, tuition, and excursions, while at the University, and on practical instruction in Great Britain and on the Continent, with the exception of fees payable to local forest officers in Great Britain and on the Continent.

10. *Allowances.*—The Secretary of State for India in Council will make payments to each probationer at the rate of £120 annually, not exceeding a total of £240 (besides the fees to local officers mentioned above). These payments will ordinarily be made on the following dates in each year:—

	£
On the 1st December	30
On the 1st March	30
On the 1st June	60

The cases of probationers whose probation does not extend over the full two years will be special.y considered.

The grant of the allowances is subject to the following conditions :—

(*a*) that the progress of the probationer in his studies is satisfactory ;

(*b*) that the probationer gives security to refund the payer s in respect of this advance, as well as such payments, not exceeding £60 in all, as may have been incurred by the Secretary of State on the probationer's behalf in respect of fees to local forest officers, in the event of uis failing to qualify for an appointment in the Indian Forest Service, or not signing the articles of agreement as specified in paragraph 13, or failing to join the Indian Forest Service at the end of the period of probation.

11. *Conduct.*—Every probationer will be required to conduct himself during the period of probation in a manner satisfactory to the Secretary of State, and to give evidence of satisfactory progress in his studies in such a manner as may be required, failing which, or in the event of serious misconduct, he will be liable to have his name removed from the list of Probationers.

12 *Appointment and Seniority.* Probationers who comply with the requirements of Regulation 8 within the sanctioned period of time, and also satisfy such other tests as may be prescribed, will be appointed Assistant Conservators in the Indian Forest Department, provided they are of sound constitution and free from physical defects which would render them unsuitable for employment in the Indian Forest Service. Their position in the Provincial Forest Lists will be determined by the Secretary of State for India in Council on the report of the Director of Indian Forest Studies ; but in making selections for the post of Conservator, officers joining the service in the same year are reckoned as equal in seniority unless the Secretary of State for India in Council shall for special reasons have directed otherwise in any particular case or cases.

Probationers will be allowed at the end of the period of probation to state their preference in respect to the Provinces to which they desire to be allotted; but the distribution will be made to the several Provinces according to the needs of the public service, at the discretion of the Secretary of State for India in Council. Officers are, however, at all times liable to be transferred from one Province to another at the pleasure of the Government of India.

13. *Articles of Agreement.*—A probationer is required, on qualifying for appointment as Assistant Conservator, to sign articles of agreement setting forth the terms and conditions of his appointment, he must embark for India when required to do so by the Secretary of State, and must engage his own passage. Failure to embark at the stated time will, in the absence of satisfactory explanation, lead to forfeiture of appointment.

14. *Passage Allowance.*—An allowance on account of passage to India will be paid to each probationer on appointment to the Indian Forest Service to the amount of £37 10*s* for passage to Calcutta, Madras, or Bombay, and £43 for passage to Rangoon.

Note.—The above is the normal rate of passage allowance. In consequence of the surtax of 10 per cent. at present charged by shipping companies in respect of passages to India the above rates of passage allowance have been raised to £41 5*s.* and £46 5*s.* respectively. Should this surtax be removed, these rates will be reduced to those given in paragraph 14.

15. *Salary.*—An Assistant Conservator of Forests will draw pay at the rate of Rs 380 a month (equivalent to £304 a year, when the rupee is at 1*s.* 4*d.*) from the date of his reporting his arrival in India.

16. *Promotion, Leave, Pension and Provident Fund.*—Promotion, leave and pension will be governed by the Regulations laid down by the Government of India, and applicable to forest officers, such regulations being subject to any modifications or alterations which may be made in them from time to time by the Government of India, and their interpretation in case of any doubt arising being left to that Government. A copy of the existing regulations can be seen on application at the India Office.

Certain information regarding appointments in the upper controlling staff of the Indian Forest Service, the pay of which has been recently improved, will be found in Appendix III; a summary of information regarding Leave is contained in Appendix IV; and regarding Pensions and the Provident Fund in Appendix V.

INDIA OFFICE,
October 1913.

APPENDICES.

APPENDIX I.—COMPETITIVE EXAMINATION.

In the event of the Civil Service Commissioners being requested by the Secretary of State for India in Council to hold an examination in any year of candidates nominated by him to compete for appointment as Probationers for the above Service, the following will be the subjects in which such candidates will be examined :—

	Maximum marks		Maximum marks.
1. English Composition ...	100	5. Physics ...	100
2. German *or* French	100	6. Geology ...	100
3. Elementary Chemistry	50	7. Botany ...	100
4. Higher Chemistry ...	100	8. Zoology ...	100

Not more than three of the subjects numbered 4 to 8 may be offered.

Candidates must pass to the satisfaction of the Civil Service Commissioners in the first three subjects.

In the subjects numbered 4 to 8, only marks showing real attainment will be counted towards the order of merit, so that a candidate who has a thorough knowledge of one or two of the optional subjects may obtain on that knowledge alone as many marks as a candidate who offers the maximum number of the optional subjects on a lower standard.

SYLLABUS.

Languages.—The examination in German and French will include translation, composition, and conversation.

Sciences.—The standard of the examination in Higher Chemistry, Physics, Geology, Botany, and Zoology will be that of the Honours Schools of the Universities.

The examination in Elementary Chemistry will consist of a written paper on the more elementary parts of Inorganic Chemistry, together with the outlines of Organic Chemistry.

APPENDIX II.—FINAL EXAMINATION.

1. With a view to the allocation of the annual Currie Scholarship for Indian Forest Students (value about £35), and to facilitate the allotment of probationers to the several provinces in accordance with paragraph 12 of the Regulations as to appointments in the Indian Forest Service, probationers who have completed their prescribed course of training will be required to undergo a competitive final examination in Forestry.

2. A list of the probationers in order of merit will be prepared by adding together (*a*) the marks obtained at the final examination, and (*b*) the marks obtained during the course of practical training in forestry under the control of the Director of Indian Forest Studies. The maximum of marks obtainable under (*a*) will be the same as under (*b*).

3. The final examination will consist of an oral examination and three or more papers, as follows:—

(i) One or more papers in Sylviculture, Forest Protection (including Forest Botany and Forest Entomology), and Forest Utilisation (including Forest Engineering).

(ii) One or more papers in Forest Management, Forest Mensuration, Forest Valuation, and Forest Administration.

(iii) A paper in General Forestry (Practical) dealing with the work done and with the forests visited during the course of practical training.

4. The final examination will be held at the beginning of October. Arrangements as to the date and place of examination will be made by the Director of Indian Forest Studies. Probationers will not be required to pay any fee for the examination.

APPENDIX III.—LIST OF APPOINTMENTS OPEN TO MEMBERS OF THE IMPERIAL BRANCH OF THE INDIAN FOREST SERVICE.

NOTE.—*This list is liable to alteration at any time.*

Appointment.	Salary. Rs.
(*a*) 1 Inspector-General of Forests	2,650 a month.
(*b*) *1 Assistant Inspector-General of Forests.	...
(*c*) 2 Chief Conservators (Burma and Central Provinces)	2,150 ,,
(*d*) 22 Conservators, in three grades (including President, Forest Research Institute and College)	1,900 ,, 1,700 ,, 1,500 ,, respectively.
(*e*) 187 Deputy and Assistant Conservators	‡ Rs 380 a month, rising by annual increments of Rs 40 a month to Rs. 700 a month; thereafter, by annual increments of Rs. 50 a month to Rs. 1,250 a month, in the twentieth year of service
Total 213†	
These appointments are included in (*d*) and (*e*): 5 Foreign Service appointments	
These appointments are included in (*d*) and (*e*): § 10 Officers employed at the Forest Research Institute and College, Debra Dun	

APPENDIX IV.

[NOTE.—Appendices IV and V are intended merely to show the principal leave and pension rules in the Civil Service Regulations at present applicable to officers appointed to the Indian Forest Service by the Secretary of State from the United Kingdom, without going into minute details, and do not profess to deal with every case that may arise. The rules are subject to alteration, and any disputed question must be decided with reference to the authorised text of the Civil Service Regulations for the time being.]

LEAVE.

Long Leave.

1. Furlough and special leave with allowances (*see* paragraph 5) are admissible to an aggregate maximum amount of six years

* The officer holding this appointment draws in addition to the pay of his grade a minimum local allowance of Rs 200 a month.

† These appointments are allotted to the various provinces as follows:—Burma, 66; Madras, 31; Bombay, 27; Central Provinces, 24; United Provinces, 19; Punjab, 12; Bengal, 12; Assam 13, and Bihar and Orissa 5; and 4 Imperial Instructors at Dehra Dun.

‡ Until he has passed the prescribed Departmental examinations, an Assistant Conservator is liable to stoppage of increments of pay. On passing the examinations he will resume drawing pay under the time-scale at the rate to which his length of service entitles him.

§ These draw a local allowance of Rs 150 a month in addition to their grade pay, with the exception of the President, Forest Research Institute and College, in whose case the allowance is at the rate of Rs 200 a month. Of these 10 appointments, the four posts of Imperial Instructors have been sanctioned for five years from 1912, for the present.

NOTE.—Under the improved scale of salary shown above, no Exchange Compensation Allowance is granted.

during an officer's service. The amount of furlough "earned" is one-fourth of an officer's active service, and the amount "due" is that amount less any enjoyed

2. Furlough without medical certificate can, if due, be generally taken after eight years' active service, and again after intervals of not less than three years' continuous service It is limited to two years at a time.

3. Furlough on medical certificate may be granted (*a*) to an officer who has rendered three years' continuous service, for not more than two years, but capable of extension up to three years ; and (*b*) to an officer who has not rendered three years' continuous service, up to one year in any case and up to such longer period, if any (but not exceeding two years in all), as the officer may have furlough "due" to him.

4. The allowances admissible during furlough are :—

(1) During the first two years of furlough without medical certificate and during so much of furlough with medical certificate as may be "due"—half average salary, subject to certain maximum and minimum limits.

(2) After the expiration of the period for which the foregoing allowances are admissible—one-quarter of average salary, subject to certain maximum and minimum limits.

5. Special leave may be granted at any time for not more than six months, with intervals of six years' service ; allowances, calculated as during furlough, are given during the first six months only, whether taken in one or more instalments.

Short Leave.

6. Privilege leave is a holiday which may be granted to the extent of one-eleventh part of the time that an officer has been on duty without interruption ; and it may be accumulated up to three months, earned by 33 months' duty. During privilege leave, the officer retains a lien on his appointment, and receives the salary which he would have received if on duty. An interval

of not less than six months must elapse between two periods of absence on privilege leave.

Privilege leave may be prefixed to furlough, special leave, or extraordinary leave without allowances. The whole period of leave thus taken in combination is known as combined leave. Combined leave may not be granted for a period of less duration than six months, nor, except on medical certificate, may it be extended beyond two years

7. Subsidiary leave in India for a minimum of 10 days, usually with half average salary, is granted to an officer proceeding on or returning from leave out of India, or on retirement, to enable him to reach the port of embarkation or to rejoin his appointment. It is admissible only at the end and not at the beginning of combined leave.

8. Short leave is also granted to enable officers to appear at examinations, etc.

9. Extraordinary leave without allowances may be granted in case of necessity, and, except in certain specified cases, only when no other kind of leave is by rule admissible. It may be granted in continuation of other leave

General Rules.

10. Leave of absence can never be claimed as of right, and is given or refused at the discretion of Government.

11. When leave allowances other than privilege leave pay are paid at the Home Treasury, or in a Colony where the standard of currency is gold, rupees are converted into sterling at the rate of exchange fixed for the time being for the adjustment of financial transactions between the Imperial and Indian Treasuries, unless any other rate has been exceptionally authorised. But for the present the rate of conversion is subject to a minimum of 1*s*. 6*d*. to the rupee. Privilege leave pay when issued from the Home Treasury (this is only admissible when privilege leave is combined with other leave) is converted at 1*s*. 4*d*. to the rupee.

APPENDIX V.

(See Note under Appendix IV.)

PENSIONS AND PROVIDENT FUND

1. An officer of the Indian Forest Service is eligible for a pension on voluntary retirement after completing 20 years' qualifying service or attaining the age of 55 years. If at an earlier date he is compelled to retire from the service through ill-health, not occasioned by irregular or intemperate habits, he becomes eligible for an invalid pension or a gratuity according to the length of his service.

The amount of pension or gratuity is regulated as follows :—

After a service of less than 10 years an invalid gratuity not exceeding one month's emoluments for each completed year of service.

After a service of not less than 10 years, an invalid pension not exceeding the following amounts :—

Years of Completed Service.	Maximum Limit of Pension.
	Rs.
10	1,000 a year.
11	1,400 "
12	1,800 "
13	2,200 "
14	2,600 "
15, 16, 17, 18, 19	3,000 "

After a service of not less than 20 years, a retiring pension not exceeding the following amounts :—

Years of Completed Service	Scale of Pension. Sixtieths of Average Emoluments	Maximum Limit of Pension.
20 to 24	30	Rs. 4,000 a year.
25 and above	30	" 5,000 "

Officers who have shown special energy and efficiency during an effective service of three years as Inspector-General of Forests or Conservator may, at the discretion of the Government of India,

be allowed an additional pension of Rs. 1,000 a year, subject to the condition that the officer must not retire voluntarily before the completion of a total qualifying service of 28 years.

Subject to certain prescribed conditions, rupee pensions are now issued to pensioners residing in countries where the Indian rupee is not legal tender at the rate of exchange of 1*s.* 9*d.* the rupee.

2. A General Provident Fund has also been established on the following basis: -

(*a*) The contribution is compulsory up to 6¼ per cent. on salaries, with voluntary contributions of not more than a further 6¼ per cent. Subscriptions on leave of any kind are optional.

(*b*) Compound interest on such payments is annually credited by Government to each officer subscribing, the rate being at present 4 per cent. per annum.

(*c*) The sum which thus accumulates to the credit of an officer is his absolute property, subject to the rules of the Fund, and is handed over to him, unconditionally, on quitting the service; or, in the event of his death before retirement, to his legal representatives or such other person or persons as, under and subject to the rules of the Fund for the time being in force, he may be entitled thereto.

(*a*) Other forms of life insurance will, however, if they fulfil certain conditions be accepted in lieu of the contributions in (*a*).

APPENDIX VI.

GENERAL PHYSICAL REQUIREMENTS.

[*Note.*—These Regulations are published for the convenience of candidates and in order to enable them to ascertain the probability of their coming up to the required physical standard. But it must be clearly understood that the Secretary of State reserves to himself an absolute discretion to reject as unfit any candidate whom he may consider, after hearing the opinion of his medical advisers, to be physically disqualified for the public service; and that his discretion is in no respect limited by these Regulations.]

1. A candidate must be in good mental and bodily health, and free from any physical defect likely to interfere with efficient performance of duty.

2. In the examination of candidates the Medical Board will apply the following table of correlation of age, height, and chest girth :—

Age.	Height without shoes.	Chest.	
		Girth when expanded.	Range of expansion.
	Inches	Inches.	Inches
19 to 20	62½ and under 65	35	2
	65 „ 68	35	2
	68 „ 70	33½	2
	70 „ 72	36	
	72 and upwards.	36½	2½
21 and upwards	62½ and under 65	35	2
	65 „ 68	35½	2
	68 „ 70	36	2
	70 „ 72	36½	2½
	72 and upwards.	37	2½

3. *Measurement of Height.*—The candidate will be placed against the standard with his feet together, and the weight thrown on the heels, and not on the toes or outside of the feet. He will stand erect without rigidity, and with the heels, calves, buttocks, and shoulders touching the standard ; the chin will be depressed to bring the vertex of the head level under the horizontal bar, and the height will be noted in parts of an inch to eighths. No fixed limit of height is imposed.

4. *Measurement of Chest.*—The candidate will be made to stand erect with his feet together, and to raise his hands above his head. The tape will be carefully adjusted round the chest, the posterior upper edge touching the inferior angles of the shoulder blades, and its anterior lower edge the upper part of the nipples. The arms will then be lowered to hang loosely by the side, and care will be taken that the shoulders are not thrown upwards or backwards so as to displace the tape. The candidate will then be

directed to empty his chest of air as much as possible. This is best done by continuous whistling with the lips as long as sound can be produced. The tape is carefully gathered in during the process, and when the minimum measurement is reached it is recorded. The candidate will then be directed to inflate his chest to its utmost capacity. This maximum measurement will likewise be noted. The girth with the chest fully expanded and the range of expansion between the minimum and the maximum will then be recorded.

5. The hearing must be good.

6. The speech without impediment.

7. The teeth in good order, *i.e.*, decayed or broken teeth must be properly stopped or crowned, and deficient teeth replaced by artificial teeth where necessary for effective mastication.

8. The chest must be well formed, the lungs and heart sound.

9. Rupture, hydrocele, varicocele, varicose veins in a severe degree, or other condition likely to cause inefficiency will disqualify a candidate, unless such condition is cured by operation.

10. The limbs, feet, and toes must be well formed and developed, with free and perfect motion of all the joints.

11. A candidate must have no congenital malformation or defect likely to interfere with efficiency.

12. A candidate must not be the subject of chronic skin disease.

13. Evidence of previous acute or chronic disease pointing to an impaired constitution will disqualify.

14. Candidates may, not more than two years before they are qualified to compete for an appointment, undergo a preliminary examination by the Medical Board, which meets at the India Office every Tuesday, under the following conditions:—

(*a*) Applications must be addressed to the Under-Secretary of State, India Office, Whitehall, London, accompanied by a fee of two guineas, and a statement of the candidate's age.

(*b*) Candidates must pay their travelling expenses.

(*c*) Candidates considered to be unfit by the Medical Board at this preliminary examination are not bound to accept its opinion, but may, *at their own risk*, continue their studies, with the knowledge that they will have to submit themselves for a final medical examination by the Medical Board, prior to their appointment.

(*d*) On the other hand it must be distinctly understood that the preliminary examination by the Medical Board is held solely for the candidate's information, and that, if after that examination he is reported to be apparently fit, he has not on that account any claim to be accepted as physically fit, when he presents himself for the final Medical Examination, upon which alone his acceptance or rejection will depend. Candidates may be considered fit for the service at the preliminary examination, but may be found at the final examination to be unfit, either on account of some physical defect which did not exist or passed undetected at the preliminary examination, or for other reasons.

REGULATIONS AS TO THE STANDARD OF VISION FOR THE INDIAN FOREST SERVICE.

1. If myopia in one or both eyes exists, a candidate may be passed, provided the ametropia does not exceed 2·5 D, and if with correcting glasses, not exceeding 2·5 D, the acuteness of vision in one eye equals $\frac{6}{12}$ and in the other $\frac{6}{6}$, there being normal range of accommodation with the glasses.

2. Myopic astigmatism does not disqualify a candidate for service, provided the lens or the combined spherical and cylindrical lenses required to correct the error of refraction do not exceed—2·5 D; the acuteness of vision in one eye, when corrected being equal to $\frac{6}{6}$, and in the other eye $\frac{6}{9}$, together with normal range of accommodation with the correcting glasses, there being no evidence of progressive disease in the choroid or retina.

3. A candidate having total hypermetropia not exceeding 4 D is not disqualified, provided the sight in one eye (when under the influence of atropine) equals $\frac{6}{6}$, and in the other eye equals $\frac{6}{9}$ with + 4 D or any lower power.

4. Hypermetropic astigmatism does not disqualify a candidate for the service, provided the lens or combined lenses required to cover the error of refraction do not exceed 4 D, and that the sight of one eye equals $\frac{6}{6}$ and of the other $\frac{6}{9}$, with or without such lens or lenses.

5. A candidate having a defect of vision arising from nebula of the cornea is disqualified if the sight of one eye be less than $\frac{6}{18}$. In such a case the better eye must be emmetropic. Defects of vision arising from pathological or other changes in the deeper structures of either eye, which are not referred to in the above rules, may exclude a candidate for admission into the service.

6. Squint, or any morbid condition, subject to the risk of aggravation or recurrence, in either eye, may cause the rejection of a candidate. The existence of imperfection of colour sense will be noted on the candidate's papers.

EXTRACTS.

FOREST INSECT RAVAGES STOPPED.

By a prompt campaign against a flourishing colony of bark beetles on the Ochoco National Forest in central Oregon the Government is eliminating a danger which threatened to destroy millions of feet of timber.

In fighting this forest scourge the method recommended by the Bureau of Entomology is followed. The simple removal of the bark of infested trees between October and July, while the larvæ are still in the tree, is sufficient to kill them. The lumber may then be sold while it is yet sound. On the Ochoco Forest, however, there was no market, and the Forest Officers found that the cheaper and more effective method of control was to cut the trees and burn them before the new broods of beetles could emerge. In 1912 the infestation was given a decided check by the cutting of 3,500 trees. This summer the attack on the insects was resumed with renewed vigor, and 42 labourers, in charge of a Forest Officer, cut more than 40,000 trees. As a result of these vigorous measures, the Government apparently has the beetles under control.—[*American Forestry.*]

FORCE EXERTED BY EXPANSION OF WOOD.

The great pressure exerted by the expansion of wood when soaked with water has been illustrated during the flood at Dayton, Ohio.

According to *Wood Craft*, of Cleveland, Ohio, a quantity of oak dashes veneered with maple was stacked to within one inch of a reinforced concrete girder in the basement of the factory of the Maxwell Motor Car Co. This girder had a cross-section of 12 by 19 in., and supported a 6 in. reinforced concrete floor.

The basement was flooded, and after the water receded it was found that the girder, together with the concrete floor which it

supported, had been lifted three inches. Ten weeks after the flood, the girder still rested on the dashes, but it had settled about three-quarters of an inch.

Large cracks developed in this girder, starting at the edge of the pile of dashes and extending upward and outward. These cracks extended from the bottom to the top of the section at an angle of about 30 degrees with the horizontal. It was necessary to replace this girder and a section of the floor.—[*Timber Trades Journal.*]

LAC CULTURE IN CEYLON.

The following note on " Lac Culture in Ceylon " was read by Mr. Drieberg at the August Meeting of the Society :—

In 1910 Prof. Dunstan suggested to the Secretary the introduction of the Indian lac insect into Ceylon. The matter was referred to Mr. E. E. Green, the Government Entomologist, who favoured the proposal, as his own efforts in this direction had proved unsuccessful. Accordingly the Secretary placed himself in communication with the Imperial Government Entomologist, and it was ultimately decided to send Mr. N. Wickremaratne, one of the Society's Instructors, to the Research Institute, Pusa, for a short course of training in lac culture. Since Mr. Wickremaratne's return, a series of experiments were conducted under his supervision ; the first trials were begun in October 1912, with imported brood-lac on masan (*Zizyphus Jujuba*). The insects made good growth but were attacked by ants and other predaceous insects. The resulting lac was pronounced satisfactory when sent to Pusa but no brood-lac was procurable for further inoculation. The second trials began in February last with imported brood-lac on kon (*Schleichera trijuga*) as well as masan. The most satisfactory results were those made on Maligatenne Estate, Kandy, with the co-operation of Mr. K. Bandara Beddewela to whom the thanks of the Society are due for the interest he took in the experiments. A sample of the lac (both stick-lac and seed-lac) are shown to-day and it will be seen that it is of excel-

lent quality. The next trials will be on the rain-tree (*Pithecolobium saman*) for which brood-lac is expected almost immediately.—[*Tropical Agriculturist.*]

THE SPINELESS CACTUS.

This really wonderful plant is not yet much known and it would prove invaluable to stock-owners and others, more especially in poor or dry districts, where vegetation of any kind is grown with difficulty. It is easily grown from the heavy leaves or slabs in any class of dry soil, and after the first year will yield according to conditions from 100 to 200 tons of succulent and nutritious fodder which can be fed to all kinds of stock and more especially dairy cattle. By analysis one ton thereof is equal in feeding value to three-fourths that of lucerne which is the richest fodder plant grown. During the hot summer months this plant would be luxuriant and being of a rich juicy nature would also greatly allay thirst and would therefore prove the salvation of stock-owners. Some of the species yield 8 tons of well-flavoured fruit per acre which makes excellent jams and jellies, etc., and growers have made up to £160 per acre. The young fleshy leaves are a good and wholesome vegetable when fried like egg-plant or boiled as greens, etc., and they also make good pickles. This very useful plant should prove a very great boon to residents in the East Indies as not only is it the heaviest yielding fruit and fodder plant yet known, but it will thrive where hardly any vegetation will exist and requires but little attention. Stock-owners particularly would find it useful.—[B. HARRISON, F.L.S. in the *Tropical Agriculturist.*]

TANNING MATERIALS.

We see the Forest Economist has put a timely note into the *Indian Forester* relating to mangrove barks for tanning which ought to usefully supplement the information given in the third quarterly issue of the *Bulletin* of the Imperial Institute on Tanning Material. Like most other forest products on which a run has been made without artificial measures being adopted to replace

the wild material extracted, the products useful for tanning, though of great variety in various parts of the world, are showing signs of failing to meet the demand and in consequence a diligent enquiry is being made into the properties of untried materials. It appears the European market has so far been depending mainly on chestnut bark, with the natural result that it is becoming scarce and dear. At the same time it seems to us that with the immense resources of India there ought to be no difficulty whatever in keeping the European market supplied indefinitely with good substitutes, provided only the materials are exploited on scientific lines in control of the Forest Department, just as it is proposed to do in case the bamboos and the wealth of wild grasses in the country are drawn on for the manufacture of paper-pulp. Considering first mangrove barks the information Mr. Pearson gives us is not only that the supply is plentiful but that extracts of good quality can be prepared that would be saleable in Europe. As to the extent of mangrove forests and localities, he tells us that a rough estimate shows there are 2,000 square miles of them to be found in Arakan, along the coast, chiefly in the Sandoway and Kyaukpyu districts; also along the coast in the Bassein district, and again in South Tenasserim in the Tavoy and Mergui districts. In the Andamans forests are extensive and also in the Sunderbuns. There appears, therefore, no limit to the supply in this country provided it is properly exploited. If all these barks are of equal quality to such as are obtainable from British and Portuguese East Africa, they must undoubtedly be of the highest quality and would command an immediate market in Europe, where the commercially accepted standard for good bark is 32 per cent of tannin, and the East African barks tested at the Imperial Institute have been found to run up to even 45 per cent. West African mangrove barks recently tested are inferior. A great many samples underwent test but only two indicated a reasonable proportion of tannin, one 22·0 per cent, the others 27·7 per cent. But even these were pronounced as not worth exporting to Europe although they might be employed locally. A point of interest was the sending of some leaves of

mangrove from the East Africa Protectorate to be tested. Of two kinds sent one was found to contain 9·13 per cent. of tannin, the other 8·78 per cent., but both contained large percentages of sodium chloride, in the one case 19·60 per cent., in the other 24·53 per cent. The report on them was unfavourable. "No. 1 produced a light reddish, harsh leather of poor quality, whilst that produced by No. 2 was similar but of slightly darker shade. The amount of tannin in these leaves is far too low to render them of value for export. It is, moreover, doubtful whether such material would be suitable for local use as, on account of the large percentage of salt (sodium chloride) which the leaves contain, they tan very slowly and yield a leather of poor quality." It is clear that mangrove leaves are not exploitable but the bark is, and ought to prove most profitable if exported to the London market, where it would probably fetch £8 or thereabouts per ton, while delivered in Rangoon the cost is a little over £1 per ton only. Another of the tan products of India is babul (*Acacia arabica*) of which both the bark and pods are available as tan extracts. The Imperial Institute has lately examined babul pods received from the Sudan and from Northern Nigeria and has pronounced favourably on the former. The consignment contained 70 per cent. pod cases and 30 per cent. seeds, and the tannin percentage proved to be 38·9 reckoned on the pod cases freed from seeds and 27·2 per cent. on pods and seeds combined. An infusion yielded a pinkish-white leather which was fairly soft and of firm texture and the opinion is expressed that the pods could command £8 per ton in the London market. The babul is a tree that grows vigorously in waste places and is valuable for its timber With a bark and pods also of high economic value there ought to be strong inducement for cultivating it largely along our sandy or kunkur ravines, where nothing else will grow while babul seems to look upon such places as its natural habitat. The Imperial Institute endeavoured to place it on the English market by lightly grinding the pods to a granular powder and sifting the product to remove seed and some of the fibrous matter which contains no tannin, but though the extract obtained showed as much as

60·9 per cent. of tannin it was not favourably received in the market, the verdict being that in the powdered form the material was not suitable for extraction purposes. We might next refer to wattle bark of which the Imperial Institute has also something to say. Of bark from India nothing is said, probably because no attempt has been made to put it to a practical use. Yet when at Ootacamund we found the Australian wattle thriving luxuriantly and lending a considerable charm to the scenery of the place, which otherwise would have been dominated by the all-too-pervading blue eucalyptus. It is this very bark apparently that is received in Europe for tanning purposes together with a black wattle from South Africa. The Commonwealth of Australia sent to England in the year 1911 £104,646 worth of bark which it is believed contained a certain proportion of mallet bark, the remainder being wattle bark. The wattle bark of which the Imperial Institute is reporting tests this year is a black wattle from East Africa. An average sample of this bark yielded 35·7 per cent. of tannin, and a sample consisting of thick bark only, 43·1 per cent. It yielded a rather soft leather of a pale pink colour and was disposed of in London at £7 10*s.* per ton. To show the importance of keeping the thick and the thin bark separate when exporting, the following figures may be quoted :—Tannin in sample containing 86 per cent. thin bark and 14 per cent thick bark, only 30·5 per cent.; tannin in sample of thin bark only 29·4 per cent.; tannin in sample of thick bark only 34·1 per cent. It is apparent that if the thick bark be supplied unmixed with the thin, while the latter shows up hardly less without the mixture, the latter makes a very good presentation and must secure very good prices. When we look at a table showing the results of examination of a large number of wattle barks received at the Imperial Institute from the East Africa Protectorates we find an extremely good record. The lowest percentage of tannin is 30·5 and the highest 43·6, with the average nearer the maximum. Prices quoted are mostly £8 per ton. The fact that the Australian wattle thrives at Ooty nearly 7,000 feet above sea-level, that a valuable specimen yielding 36·9 per cent. of tannin is obtainable in the Victoria

Nyanza Basin at an elevation of 4,000 feet above sea-level, and that it grows at lower elevations elsewhere, shows that it would thrive as a plantation product in many parts of India; and if it pays to cultivate it in the African colonies as a tanning material it would likewise pay to do so here. Mr. Pearson makes mention also of divi-divi pods as a source of tannin, and we find a favourable account from the Imperial Institute of a sample received from the Gold Coast. Although there was evidence that these pods had been collected in an immature condition they yielded 33 per cent. of tannin, the usual percentage found in the divi-divi of commerce being from 40 to 45. "The pods are richest in tannin when just mature, and after collection at this period the pods should be split open longitudinally, the seeds removed, and the husks dried as rapidly as possible. Slow drying frequently allows fermentation to commence, with the production of red colouring matter which diminishes the value of the material." Although the pods tested at the Imperial Institute did not comply with any of these conditions, the tannin still yielded a soft pale brown leather of good texture and appearance. The Institute has tested a great variety of tanning materials besides those alluded to, some common in India and Ceylon; and it is beyond dispute that if this country now set itself to exploit the best of them, it would in a great measure capture the European market which has to-day reached a crisis similar to the one it is experiencing in connection with the paper-pulp industry.—[*Indian Planters' Gazette.*]

INVERLIEVER.

I.

A STATE FOREST IN THE MAKING.

In forestry, and more particularly in forests owned by the State, Great Britain lags noticeably behind any other great European nation While countries around us are exporting their timber, we are importing it to the value of some £26,000,000 yearly, though the time may come when these sources of supplies are permanently shut down owing to the exporting countries finding a home market for their wood. It is because of this fact

that the one and only Government demonstration area north of the Tweed—Inverliever—is of special interest at the present moment when the question of arresting rural depopulation has been brought much before the public, and when reliable authorities have advocated State afforestation as one of the most satisfactory means of retaining the population on the land and of bringing to glens now desolate a new set of workers to take the place of those who have drifted into the cities or who have crossed the seas in search of more remunerative employment.

It is thus that the 12,500 acres lying along the north shore of Loch Awe have great possibilities before them. To justify the forecasts of the supporters of the scheme there must, at the end of the next fifty years or so, arise a thriving industry affording employment for a colony of crofters who, while permanently employed by the State, will at the same time have a means of providing themselves with some of the necessities of life from the few acres which will go along with their crofts. It is necessary to make the strongest point possible of the advantages inseparable from the creating of small holdings in connection with a scheme of afforestation. The Government may have the creation of these holdings in view, but their action in this respect has up to the present been disappointing to those who look to this method for the introduction of steady, reliable families into the district. The ground has been in the hands of the State since May 1908, and yet during these five and a half years only a single small holding has been erected. There are at the present moment two small holders on the ground, but the holding of one of these men dates from a time considerably before the acquisition of the land by the Government. The two houses are built distant from each other only a few yards, and are on land immediately above the loch, with a southern aspect. Each small holder has some 10 acres of land suitable for cultivation, and there are also about 18 acres of common grazing land. Both small holders are married. The first to be established—in a croft already formed on the ground—is an Aberdeenshire man of middle age, who supervises the work of the men employed on the hill. He keeps a pony and couple of cows,

while his wages are 24s. a week. The rent paid for the holding is, I believe, about £8 The pony is used for carrying up the young trees to the hill. Specially constructed crates are employed, and one is slung—pannier like—on each side of the horse. At a stretch it has been found possible to pack 5,000 trees into the crate, which means that on a single journey as many as 10,000 may be carried to the high grounds. Sometimes, however, in the case of the larger plants, 1,800 to 2,000 make up a full load. It is a fact worthy of note that only a small proportion of the 10 acres of agricultural ground is under cultivation—in the corner of his oat stubble is a miniature nursery of young spruce—and it appears that hereabouts the growing of oats is not a remunerative proceeding, for the grain can be bought almost as cheaply as it can be grown. The holder is, however, in possession of an extremely fine crop of roots at the present moment.

The second holding was established as recently as last May. It is a substantially built house, and has been erected for the trapper of the forest, a married man permanently employed in the destruction of the rabbits on the estate. His wage also is 24s. a week, and he keeps a single cow. Reckoning the value of a cow as £8 per annum, the position of these two crofters seems to be one of comparative comfort. But, so far as can be gathered, there is no immediate prospect of the establishment of further holdings of this sort on the area, and this cannot but be regarded as regrettable. At the present moment the accommodation for men working on the hill consists of an erection known locally as the bothy. This is a wood-and-iron structure, with a number of small bed-rooms opening off a single corridor, and is looked after by a Gaelic-speaking caretaker and his wife. There is accommodation for ten men, but at present the muster is six only. It is extremely doubtful whether the erection of this bothy is beneficial to the forest. The men it attracts—as a matter of fact, the problem of obtaining labour is a most serious one—are of the wandering class, and we hear there is only a single man remaining of those who occupied it upon its erection. The bothy may be a shelter, but it cannot be looked upon as a permanent home, and there is no

accommodation in it for married men. The result is that those men who live there and work for a time will never remain in the district permanently, and the permanent settling of foresters in the area is a point strongly emphasised—and rightly so—by those in favour of State afforestation. It has been said that there are no applications for such small holdings. This is probably true, for the Highland crofter is cautious and slow-moving by nature, and must have some definite and obvious inducement before he will decide on a new undertaking. But let half a dozen holdings be erected, and the probabilities are that tenants will be found for them before long, and tenants, too, of a class superior to those who will be attracted by bothy life. At the present moment the forest can be kept going by a staff of twenty men—as a matter of fact sixteen is the number on the ground at the time of writing, but as time goes on this staff must be very largely increased, and in fifty or sixty years' time there must be work for 120 men. It can thus easily be realised that the one and only method of retaining a population of this size on the ground is by the erection of a number of holdings on the area sufficient to house the community. Broadly speaking, the area suited for the erection of such holdings is the whole length of the estate along the shores of the loch. At New York on the north, and at Ford on the south, are situated the lands best suited for cultivation, but the objection raised to them as the sites for holdings is that they are at present too far removed from the planting area. This objection is justified, but there is also ground between these two points on which holdings could be erected. It is by no means necessary to have as many as ten acres of ground going along with the croft; what should be aimed at is just sufficient to enable the forester to provide himself with some of the necessities of life—the great point is that the worker would be provided with a definite and permanent home which would do infinitely more to keep him in the district than all the inducements of bothy life. The existence of a bothy may be justifiable as a shelter for young lads, but this is the only use to which it should be put. No doubt the erection of holdings must be one of considerable expense in such an out-of-the-way district, but I venture to

believe that the expenditure of certain sums in this way would result in great benefits, and the experiment would be once and for all made of demonstrating the value of afforestation in the stemming of the tide of rural depopulation. The difficulty of providing an education for his family faces the small holder in these parts, but with the erection of, say, half a dozen holdings a tin schoolhouse might be provided near. At the moment of writing there are, apart from the foreman and trapper already mentioned, six men at work on the forest proper. Four of these are paid at the rate of a sovereign a week—the remainder are engaged in cutting drains and are paid piece-work, being able in summer under favourable circumstances to earn up to 30s. a week. The men employed in the nurseries, which are situated at Ford, are paid at a slightly lower rate—18*s.* a week. Broken time is prevalent during the winter months, especially at the end of the year. Thus in October, 1912, £1 16*s.* 3*d.* was lost from this cause; in November, £6 6*s.* 3*d.*; in December, as much as £11 10*s.* 5*d.*; in January, £6 11*s.* 5*d.*; in February, £8 16*s.* 8*d.*; and in March, £4 12*s.*—a total for six months of £39 12*s.* 11*d.* This works out at an average of just over £6 12*s.* per month, or one day in a fortnight lost owing to bad weather. Almost the whole of this broken time was due to rain, and during last December alone a station near Oban measured over 20 inches. I believe that only on one occasion was a townman engaged on the estate. The isolated character of the district was pointed out to him, yet he still held to his determination to undertake the new work. He arrived on a Friday, and although the weather during the next two days was excellent, he left early on the following Tuesday, in spite of the fact that he was strongly persuaded to give the place a more extended trial. Of the sixteen men now employed in the forest, the average age works out at about thirty-five years, but this figure is perhaps somewhat misleading owing to the fact that three young men left the station a short time ago.

It must be admitted that the difficulty of inducing a good class of workman to settle in the district is greatly increased by the remote and isolated position of the ground. From November

until May no passenger steamers run on Loch Awe, and the nearest railway station is Oban, thirty-two miles distant from Ford. The remote character of the country will, we imagine, be a serious obstacle to be faced when the time comes for the transporting of the wood. This will have to be towed to Loch Awe station, some twenty miles distant, and thence carried by rail to its destination—that is, unless a light railway is constructed to the Atlantic. The most simple method would appear to be the floating of the logs down the river Awe, but we hear that difficulties would arise in the form of damage done to the banks of the river, and—this is the chief point—to the spawning beds, for it would be possible to float only during the close season of the fishing, and, consequently, precisely at a time when the salmon were on the redds.

II.

It will be as a conifer-bearing area that Inverliever will be known in years to come. Except for a small strip running parallel to the loch the ground is quite unsuited for the successful production of hardwood, and even here that rapid growing tree, the Douglass fir, will probably yield more remunerative results than, say, the ash or the oak, though it might, perhaps, have been wished that a few of the more valuable hardwoods had been planted for experimental purposes. As it is, beech and a few willows are the only broad-leaved trees reared in the nurseries at Ford. Wherever possible, larch is being planted on the hill slopes, and there are thriving young woods of Douglass firs in certain sheltered spots, but a large percentage of the area is on high-lying and poor soil, with a good deal of boggy land, and here the spruce is the only tree which can show a healthy growth. It is probable that quite 50 per cent. of the whole of the plantable ground will in time carry these conifers. Two species of spruce are of commercial importance in this country, and both are being planted at Inverliever; of the two the Norway spruce is perhaps the better known, but its relative, the Menzies spruce—*Picea sitchensis*—is of great service in the covering of sour, boggy land. This

tree will stand a greater amount of moisture on acid soil than any European species, and it is intended to utilise it in planting up the boggy plateaux which are so plentiful at Inverliever.

The formation of large tracts of spruce-bearing country with difficulties of transport in the future at first sight appears a somewhat doubtful policy, but the idea is, we believe, to construct a pulping plant in the district when the trees reach maturity. For the financial success of such a plant at least 3,000 acres of spruce would be required, but that number will probably be in existence at the end of the next fifty years. It is in connection with the two species of spruce that the well-known but little practised "upturned turf system" is being employed. A network of drains, 13 ft. 6 ins. apart, is constructed through the bog, and the turf obtained in the making of the ditches is cut into sods. These sods are distributed over the area at a distance of four feet apart, and in the centre of each sod a young spruce is planted. The advantage claimed for this method sometimes known as the Belgian system, is that the small tree is clear of the stagnant water and harmful gases of the bog until the drainage has become effectual. This system, is more or less dependent on a heavy rainfall, in which respect the west coast is specially favoured. Spring planting at Inverliever yields the most successful results, and this year it has been decided to plant out no trees during the present month. The experience acquired during the past four years is that the planting done during the month of May has yielded the largest percentage of healthy trees, while those set in from November to January have done worse.

An attempt has been made to introduce Scots fir, an attempt attended with disastrous consequences. Scots fir is not found in this part of Argyllshire, and the blackgame of the neighbourhood evinced such a taste for the tender shoots of the young trees that whole plantations have been destroyed. The shooting is let, but the Government obtained the consent of the tenant to its proposition that it should be entitled to shoot the birds when actually damaging the trees, but I believe these shooting powers have resulted in a certain reduction of the shooting rent. Following

on the new agreement, thirty black grouse were shot and handed over to the tenant during last winter, but the birds are at present as numerous as ever, and the planting of *Pinus sylvestris* has been discontinued. The blackgame also do a considerable damage to the young shoots of the larch during the months of March and April, but the injury done to this tree has not the same crippling effect as to the Scots pine, as the larch throws out with comparative ease a new leader to take the place of the one destroyed. Owing to the fact that blackgame shooting ends on December 10th, it is impossible to take effective measures against the birds, and it has been suggested that a Commissioner should be appointed with full powers to authorise the shooting of the black grouse at any season of the year provided they are actually engaged in damaging the young plants. Various experiments were tried in the endeavour to preserve the trees. String was stretched from long stakes set at intervals over a plantation of young firs in the hopes of scaring the birds. Then a miniature windmill was erected. This in the course of its revolutions set in motion a small ball, the rattling of which would, it was anticipated, keep the blackgame off the ground. This, too, was a failure. Finally grain was strewn near the feeding grounds, but though jackdaws and other birds were attracted, the black grouse failed to take advantage of this attempt at hand-feeding. Rabbits in the past have done much injury to the young trees—after one heavy snowfall they destroyed 25,000 larches through breaking in from an unexpected quarter, but during last winter mountain hare were more troublesome in this respect. Squirrels are absent —there are only some 90 acres of grown wood on the whole area—and mice are kept down by kestrels, which appear to be specially numerous hereabouts, and which are to be seen constantly hovering above the banks sloping down to the loch.

The present scheme is to plant 150 acres a year and to aim at a sixty years' rotation, though it is not as yet quite certain how many of the 12,500 acres will actually be put under wood. Planting is expensive, the cost in connection with the draining of the ground amounting in cases to over to 10*s.* an acre. To take an

extract at random—8*s.* 6*d.* for preparing the ground (apart from draining), 19*s.* 1*d.* for planting, 4*s.* 2*d.* for freights, cartage, and haulage of plants. To this must be added the cost of the plants—during the last season 446,000 trees were planted, out of which 24,000 were not home-grown—the fencing, the filling in of gaps, and the expenses incidental to the trapping of the rabbits. Thus a moderate estimate puts the cost of planting an acre at £4, or rather over that figure. The planting of large areas of spruce and larch in proximity to each other suggests that the larch aphis—*Chermes laricis*—which undergoes a portion of its life cycle on the larch and the remainder on the spruce—may put in its appearance at a later stage, but this fear may be groundless, because the situation is an extremely open one and unsuited for the spread of injury, whether caused by insect or fungus. Latterly a number of Japanese larch have been planted out, and should do well in the mild and humid climate.

The most thriving plantation on the area is at the present moment a young crop of Douglass firs planted four years ago. The Douglass is almost immune from enemies, and the only damage done to the plantation has been through roe deer, which have eaten the leaders of a few of the trees. A good deal of extra labour has been entailed in clearing the hillside, before planting, of the strong growth of bracken, which is usually present. Over the west coast of Scotland generally there has been a marked increase of this troublesome fern during the last quarter of a century. The reason for this increase is somewhat obscure, but a theory advanced is that it must be set down to the decrease in the number of cattle on the hillsides, and to the fact that the remaining beasts are usually hand-fed during the winter months. At Ford, at the south-western extremity of Loch Awe, the Inverliever nurseries cover eight acres of ground, but only a proportion is given over to tree cultivation, and a certain amount of the land was under oats last summer. This season 361,000 trees were lined out, and areas of silver fir, spruce, Douglass fir, and Japanese larch, among others, were sown. There is one noticeably fine area of Japanese larch at the present moment.

Though November is half over, some of the trees are still growing, though the general appearance is that of a strip of oats, ready for the reaper. Other trees noticeable are the Corsican pine, the European larch, and the mountain pine. This last tree is being cultivated with the idea of affording protection on exposed ridges, as, owing to its straggling and bushy character, it offers a good wind screen to the young trees planted in its shelter. It is also held to be an improver of peaty soil. The figures for the rainfall at Ford and Cruachan bothy (near the northern march) may be of interest :—

1910	Cruachan,	82·08;	Ford,	70·91.
1911	Cruachan,	97·95;	Ford,	78·24.
1912	Cruachan,	95·59;	Ford,	76·62.
1913 (up to Oct. 31)	Cruachan,	55·44;	Ford,	47·63.

Cruachan lies at a higher level than Ford, but yet the difference in the figures is striking, considering that the two stations are only eight miles distant from each other. During the last two months of 1912 the rainfall at Cruachan exceeded that at Ford by no less than 7 inches. From the figures recorded at Cruachan there is little doubt that at the higher levels—and its highest point, Inverliever, reaches an altitude of 1,400 feet—the rainfall must be considerably over 100 inches per annum, so that the prevalence of extensive tracts of bog land, and thus of unsatisfactory conditions for the majority of young trees, even of young conifers, would appear to be inevitable.—[SETON GORDON, F.Z.S., in the *Scotsman.*]

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KHEDDAHS NOW AND TWO THOUSAND YEARS AGO.

Whenever a Governor-General of India visits the Madras Presidency, the Maharaja of Mysore is able to show him a spectacle which is nearly unique throughout the wide world, namely, the capture of whole herds of elephants at one fell swoop. These captures are known as "*The Kheddah Operations.*" Everything connected with that great Leviathan, the elephant, seems to make a strong appeal to the imaginations of most people and consequently whenever the Kheddah operations are in progress, they attract a considerable amount of attention and afford excellent and no doubt very welcome "copy" for the local papers. The recent Kheddah in Mysore has just terminated most successfully, and as the subject is still fresh in people's minds, some of your readers may be glad to glance through the following remarks concerning the manner in which Kheddah operations were reported to have been conducted in India as far back as two thousand years ago.

This interest in the elephant is no new thing. Little as we know about Ancient India, and putting aside Philosophy,

Astrology and Religion, it is rather surprising to find that the most detailed accounts on any single subject connected with really ancient Indian life, is to be found in the description of the various methods used in the capture of the elephant. As time goes on, indigenous records will no doubt be more freely forthcoming than they have been in the past and this will lead to their skilled collation and publication. If and when this time arrives, the elephant will doubtless be deposed from his pride of place; meantime however he holds the field.

Of the various methods mentioned by the old Greek and Latin writers as being in vogue among the ancient inhabitants of India for capturing elephants, the Kheddah system has been described very fully. The period from which the following résumé is taken lies between B.C. 300 Megasthenes to about A.D. 130 Arrian. Megasthenes was a man who had himself been in India. The only reward he obtained for his enterprise in leaving on record his account of the country was to be proclaimed to the world for centuries afterwards as a first class liar. Indeed he would have been raised to that highest class of liar—the "Expert"—had he not been vicariously robbed of that distinction by another writer called Deimachos. Strabo for instance—who was himself a bit of an "Expert"—roundly asserted that Deimachos was the Arch-liar and proceeded to place Megasthenes next on his list with regard to the men who wrote on India before his (Strabo's) time. But although Strabo unblushingly bespattered Megasthenes' memory, this in no way deterred him from making free use of his record. The better balanced mind of Arrian was more discriminating. He catalogued Megasthenes as "an approved man," made much use of his writings and very handsomely acknowledged his indebtedness to him. Megasthenes has by now been restored to his rightful place, thanks chiefly to German scholarship. In fact, any one knowing the W. and N.-W. coasts of India to-day who reads the collated extracts from Megasthenes' lost work, can in many cases trace what he meant to convey and how he fell into some of the blunders that he made. It is to be remembered also, apart from considerations of corrupt texts, that what we read of

him now is what other people said that he said—a very different thing from what he may really have said. This digression is not out of place because it is no use relying on a witness unless we know what degree of confidence may be placed on his statements.

Strabo and Arrian's versions of the Kheddah operations follow that of Megasthenes with some few additions. It is not necessary therefore to separate what each wrote, and it is hoped that the following *précis* may be taken as a fairly accurate representation of what has come down to us:—

The Indians hunted all wild animals in much the same way as the Greeks, but they captured the elephant in a manner which was quite peculiar.

A convenient and level spot was chosen, of a size which was ample enough for a large army to encamp on (five or six furlongs in perimeter according to Megasthenes followed by Strabo). A trench 30 ft. wide and 24 ft. deep * was then dug round this perimeter and the spoil from it was thrown up along the outer side to form a bank. At intervals within this bank were formed hiding places which were provided with loopholes from whence to observe the approach of the beasts and the exact moment when they entered the enclosure. Only one entrance to the enclosure was left open and this consisted in a bridge (width not specified), covered over with a deep layer of earth and turf and leaves so that the animals might not suspect the existence of the bridge either before they came to it or when they were passing over it. A few very tame and well trained cow elephants were next driven into the enclosure to act as decoys, and the observers then returned to their hiding places to await the development of the situation. It was considered as hopeless to expect a wild herd to enter the enclosure by day, but during some night time the herd would smell or hear the cows, and in their desire to reach them would enter the trap. The whole herd would be trapped because, being always led by a large male, wherever the male went the rest would follow. Those watching in the shelters, knowing what had occurred, immediately proceeded to

* A seeming corruption of the text.

demolish the bridge, news of the successful capture was sent to the "adjoining villages' and the Kumakis were brought up and kept in readiness for their part in the proceedings. Meantime the enclosed herd was kept without water (food in the actual accounts) in order to weaken and cow them. When the psychological moment had arrived, the bridge was rebuilt and the Kumakis taken in for the roping operations. A furious battle then took place and continued until the Kumakis obtained the upper hand, when the roping commenced. First the leg ropes were put on and then the neck ropes. But in order that the neck ropes might have better effect, the necks of the wild elephants were incised with knives so that the ropes (which are described by Strabo as being made of raw ox-hide) might severely hurt the animals whenever they struggled and hence make them less ready to "shake their heads,' and thereby throw off the men who had mounted them. Being by now sufficiently weakened, cowed and roped up, the captured animals were tied neck and neck to the tame ones and led off to their stables On arrival, they were then tied neck and leg to stout posts and given food (? and their, by this time, much needed drink). At first the new captures refused to eat and so the Indians stood round them and cheered them up with music and tom-toms, on which the animals became so soothed as to take to their food. During the process of roping up, the very young ones, the very old and the obviously useless ones were purposely allowed to escape and no further notice was taken of them.

The above description raises several interesting lines of thought. First of all, the bridge; and I take this first because the other writers have closely followed Megasthenes. The stress that is laid on the deep layer of soil placed above the bridge (which was therefore evidently built low down in the ditch) indicates that it really was a bridge that had to be passed and not a narrow cut of solid ground left between the extreme points of the ditch perimeter.

It will be noticed that there is no reference whatever to the Preliminary and Final Drive which is such an important feature of the present day operations. The ancients were, if anything,

more highly skilled in their knowledge and handling of elephants than the men of the present day. They would have had no difficulty in fixing on suitable spots for the Kheddah enclosures, as they would have been well aware of the movements and migrations of the herds and their routes. It seems probable too that the Kheddah sites, once selected, were used for several operations, for the mass of fresh earth thrown out of a ditch of the dimensions given would have acted as a "stop" to every herd in the neighbourhood, no matter how cunningly the cow decoys may have exercised their blandishments. In spite of all this, it seems strange that driving was not resorted to. But the fact of its not being mentioned is a guarantee that it was not practised. For Megasthenes' veracity is borne out by the mention of the loopholed shelters which otherwise would not have been necessary. In the absence of driving, these shelters were essential. It might be days or even weeks before a wild herd entered the enclosure of its own accord, and unless the watchers were continually on the spot and ever on the alert, prompt action in dismantling the bridge could not have been taken immediately the herd was entrapped. The shelters therefore seem to have been designed solely for concealment and not for the purpose of safety.

As a corollary of these two items, the omission of any mention of the modern poised gate is significant and explainable. At first sight a poised gate is a much simpler engine than an elaborate and strongly built bridge. But two reasons may be adduced for the course reported as having been adopted. A poised gate necessitates a narrow entrance and a narrow causeway, whether bridge or solid ground. The depth of the ditch is given as 24 ft., but assume that the texts had become corrupted and the depth was 12 ft. Further, even assuming that the ditch was wedge-shaped, which would make it less alarming to the animals, it would be improbable that not one alone but a whole herd of elephants would trust themselves on to such a narrow causeway flanked on each side by a deep ditch. Much less would this be the case if the ditch really had been 24 ft. deep. Again we are told that the captured animals, as soon as they were roped up, were taken

out of the enclosure. It is true it is added that they were quite cowed. But in any event it would be a ticklish job to take elephants two if not three abreast (they were tied neck to neck), with perhaps one or two others butting in behind, over a narrow causeway flanked by a ditch 24 or even only 12 ft. deep So we may conclude that there really was a bridge and that the ancients had excellent reasons for preferring a bridge to a gate, even though this bridge involved twice building up and twice dismantling. Also it seems a fair inference that the bridge was constructed of a good width, not only with the object of minimising any likelihood of terror of the ditch when entering the enclosure, but also with a view to allow plenty of room in case any elephant suddenly played up while being conducted out of the enclosure.

The statement that very young elephants were deliberately allowed to escape indicates that herds were not only plentiful but easily captured whenever desired Also that Kheddah operations were of pretty frequent occurrence and their management well understood. Elephants in those days were used not only in the arts but for war and for export; and from these causes, not to mention disease and death, the depletion of the tame stock was presumably pretty considerable and made frequent replacement necessary. An elephant does not mature till it is 25 years old and consequently, if they were easily obtainable by capture, it would not have been worth while to keep the little ones till they grew up. A much later writer Kosmas Indicopleustes (5th century A.D.) mentions that elephants in India were sold by height measurement and at so much a cubit. If this was also the standard of exchange at our earlier date, small calves would have had but little value as the sale money would have been eaten up by the cost of the journey from the forest to the Sale Mart, in addition to the risks and deterioration in taking them there. On the other hand if Aelian (not the military writer) writing a little after the middle of the 2nd century A.D. can be believed, young elephants were expressly caught by the Indians and carefully reared "like children, with great care and attention." But as he precedes this statement by asserting that Indians did not attempt the capture of full-grown

animals, his testimony is open to suspicion. We know that full-grown elephants were caught and Arrian lived just prior to Aelian. We know further that it is much more dangerous to cut out and catch a calf from a herd than it is to catch a full-grown elephant, and it is quite improbable that people who could not, or dared not, catch full-grown animals would ever make a second attempt to catch a calf. In a huge and diversified country like India, and in a country where elephants were so well understood and sought after that they were merchantably and aesthetically classified into types by ancient writers, we may perhaps be safe in believing that the truth lay midway between the two statements, and that young elephants were caught in some parts of India and not in others. In some parts it would be worth while to catch them and retain them when caught, in others it would not. In some parts local custom or other cause would let them go free, in others it would not; and so on.

The account states that the wild elephants were mounted while yet in the enclosure and that the necks of these elephants were incised in order to facilitate the mounting and to enable the riders to keep their seats. This is further emphasised by a statement which I have omitted from the *précis* given above. This is to the effect that the wild elephants were deliberately knocked and severely beaten by the Kumakis. The account states it was necessary to do this in order to allow the mahouts to mount the wild elephants while they were yet on the ground. It is extremely improbable that this portion of the description was correct Animals might be knocked down and beaten in the rough and tumble which accompanied the roping up, but it is improbable that it was done for he reason assigned, because it was entirely unnecessary. First, because there was no need to mount the animals at all: and secondly because if they had been mounted, it would be easier to mount them, after they were tied neck to neck than when they were lying on the ground with the battle of other elephants swaying above and all round them. The men attempting this would have been trampled to death or disastrously injured. In my opinion, the reason for the incisions was to prevent the rider of the tame elephants being

shaken off at the stage when the wild elephants were marched out of the enclosure. If a wild elephant is tied only by the neck to a tame one or even two tame ones, it must be tied very close up and with no space allowed for the play of the ropes. Otherwise the wild elephant can skew round at an angle to the tame one and bring his trunk into play against the rider of the tame animal If he is tied close up he cannot reach the rider of the other elephant with his trunk. On the other hand if the elephants are tied up so close as this, the wild one by shaking his head would so shake the other elephant as to render the seat of the rider a precarious one. Only those who have seen an elephant shake its head in anger can appreciate the force with which it is done. But the best tying in the world with the huge ropes used is apt to work loose during a titanic struggle, and therefore it was of first importance to deter the animals from shaking their heads by rendering the act as painful as possible. We are expressly told leg ropes were used during the roping up and we are as expressly told only neck to neck tying was used in the march off (and hence that the leg ropes were not relied upon at this subsequent stage). The reason for this is quite clear owing to the necessity for passing over a causeway flanked on both sides by a deep ditch. To-day the ends of the neck ropes are fastened to two animals in front and the end of the hind leg rope (or if necessary two leg ropes) tied to an animal (or two behind. The wild animal is thus free to move between the three and has plenty of space to do so. Many animals by the time they are roped up have become sufficiently exhausted and cowed to allow themselves to be led away quietly. But many others continue to make a great fight of it, and it may take all the time of three or even four tame ones to move the wild elephant along. This is all very well where there is plenty of ground to play about on, but such a method could not be used where a part of the march was restricted to a narrow causeway with a dangerous drop on either side.

Indicopleustes[mentions that elephants were caught in his time in India and it seems a pity there should be a gap of 1,300 years from his time till now in the history of these Kheddah operations. It is probable that there are indigenous records existent by means

of which the gap could be filled in. If this paper induces any Indian reader to take steps to bridge the gulf he will be performing a service which will be appreciated in time to come. My best wish to such an one is that he may succeed in building a bridge as sturdy and successful as the bridges the Old Timers built in order to achieve their object in luring their elephants into their service. For there is no doubt about it that well treated tame elephants love their life and their close association with man and are happier thus than in their wild state. They become so affectionate and amenable that even a little child may lead them. If Plutarch is a safe guide, the ancients regarded their mastery over the animal world in a very serious light. In his essay on Fortune, Plutarch says: "What is huger or more formidable in appearance than the elephant? Yet it becomes man's diversion and a 'turn' at public games for which it learns to dance and to kneel. And all such sights are not idly introduced but rather to the end that they may teach us to what heights reason raises man and over what things it sets him and how it makes him master over everything."

It would indeed be a good thing, and especially in this country, if some of us living to-day regarded our association with animals from the same high standpoint.

MANANTODDY,
MALABAR.

F. FOULKES,
I. F. S.

THE CONCENTRATION OF REGENERATION OPERATIONS.

By force of circumstances the Selection System was originally adopted almost universally for the forests of India when they were brought under the management of the Forest Department. For some years past, however, there has been a growing feeling amongst forest officers who have had to deal with coniferous forests, and probably amongst others as well, that this system was unsound in theory for the forests in question and unsatisfactory in practice. The system as practised has recently been condemned in the pages

of the *Indian Forester* for financial reasons, but it is in its effect on reproduction that forest officers have found the chief cause for uneasiness.

Now in the ideal forest worked under the Selection System fellings are not required to induce regeneration ; all age classes are at all times represented on the ground, and the only operation required is the removal of trees as they became mature. The impression that this theory of exploitation could be applied to the forests in question with beneficial, if not entirely satisfactory, results was probably in the minds of the early forest officers in India. Even then probably many of them looked upon the Selection System as a temporary expedient, and it was not long before the above theory gave place to the conviction that fellings must be made so as to aid regeneration ; unfortunately this conviction was not followed up to its logical conclusion. In making Working-plans attention was still not paid to the fact that regeneration cannot as a rule be established by one operation, but that one felling must be followed by others which shall continue to carry out the idea of the first and aid regeneration which has resulted from it ; the only indication that the necessity of regeneration operations was recognised was the prescription that trees should be felled in groups, and this prescription was generally nullified to some extent by the imposition of a girth limit. Year after year trees were marked for felling without any idea of what had been done before or what would follow after, and the position was generally made worse by an underestimate of the possibility which precluded even a chance return to an area already operated on within sufficient time to continue the idea of the first felling. The results of such working are :—

(*a*) That regeneration is generally insufficient to provide for the maintenance of the yield.

(*b*) That such regeneration as does appear is often rendered useless by failure to assist it by subsequent fellings and cleanings.

(*c*) That such regeneration as there is is being scattered over the whole forest, there is room for considerable differ-

ence of opinion regarding the extent to which it has failed, resulting in divided counsels as to future management.

(*d*) The attainment of the normal forest is probably further off than when operations started.

(*e*) The future yield of the forest will be very irregular, and no idea can be obtained as to what it will amount to in each period.

In my opinion the present state of affairs must continue until regeneration operations are concentrated. Only when this is done will it be possible to give the necessary continuous attention to regeneration, to detect failure, and to appreciate the results of the various measures adopted to assure success. To give a few examples:—I recently spent a short time marking deodar in the Kaghan valley in the Hazara Division. Regeneration seems to be ample wherever it has a chance, but a dense crop of Parrotia often prevents it from appearing or prevents its growth when it does appear, and everywhere one sees seedlings hopelessly stunted in growth owing to the overshade of trees of the parent crop as well as of fir and blue pine. Obviously what are required are cleanings, probably several successive operations, and certainly several operations at short intervals in regeneration and improvement fellings; but owing to the fact that under the present Working-plan no area can be returned to until every compartment containing mature trees has been worked over, there is no chance of these being carried out. As far as I remember the average period of return to the same compartment is 15 years, but in some of the compartments in which I marked the yield prescribed at each operation can be obtained from a very small portion of the compartment, and consequently it is probable that an area will not be worked over a second time for 30 or 40 years or more. The results of 25 years' working under Working-plans of the *Pinus longifolia* forests in the Rawalpindi Division have been that practically all the regeneration produced in that period has been destroyed by fire, the attempt to protect the whole area of the forests (necessary of course under the Selection System) having resulted

in the eventual burning of every area before seedlings could be established. In the Deodar forests of Chamba and Bashahr it is stated that many areas are failing to regenerate, and the extent of failure, the cause, and the remedy are matters on which the last two Punjab Forest Conferences have shown opinion to be greatly divided.

Having decided on concentration and fixed the current regeneration block and the length of time in which it is aimed at regenerating it, it is probably generally unnecessary to insist on the application of a particular system of marking. Indeed in my opinion there is a considerable danger of the all important question of concentration of regeneration operations becoming obscured by arguments on the comparative merits of various European systems of natural regeneration for Indian conditions. These systems are the result of evolution and are practised in forests which have been under scientific management for centuries; discussion as to whether one or the other system should be applied exclusively in an Indian forest of the usual type seems therefore unprofitable. Incidentally it may be remarked that the European systems are not always so stereotyped as they appear on paper. The Shelter-wood Compartment System is perhaps generally somewhat stereotyped and mechanical in practice simply for the reason that it is generally applied to forests which are uniform in character and which present no great difficulty in regenerating. This is not the case with the Group System, which is applied to forests less uniform in character and less easy to regenerate. The system is named from the initial seedling felling gap, but many other operations besides the cutting and enlargement of this gap are carried out, and these operations differ in different localities. The system is still in the process of evolution and many alterations in its application have been made in the last few years. It is true that the manner in which the fellings are made does to some extent affect the length of the regeneration period and hence the number and size of the regeneration blocks, but, provided the annual yield is fixed by volume (obtained in the absence of yield tables by enumerating in small girth classes and ascertaining the average volume of a tree in

each class), any error can be easily rectified when the plan is revised.

Something has already been done in the way of concentrating regeneration operations in some forests in some provinces, in the *Pinus longifolia* forests in the United Provinces for example; but there is great hesitancy to give the idea wide application. Some foresters are afraid to concentrate where regeneration is known to be difficult, but surely these are just the cases where there is the greatest need of concentration; certainly thereby failure will become more obvious, but to decide against it for this reason is to act like the ostrich. It is difficult to believe that regeneration can be made more difficult to obtain by concentrating regeneration operations. To take an example, there is a theory that in some fir (para. 37, Jaunsar Working-plan) and deodar forests in the Himalayas nature ordains a period for the ground to be fallow before the regeneration of these species, and, in the case of the latter species, this supposition has been used as an argument against concentrating regeneration operations and a more rapid removal of the mature growth (Punjab Forest Conference, 1913). Surely the argument is, however, all the other way; if nature wants the land to be fallow that means that she wants as little as possible of the species in question on the ground for a certain time, whilst other species (broad-leaved are suggested in the case of fir and blue pine in the case of deodar) come in and prepare the ground for the regeneration of the original species. That is, I believe, the theory, and if it is correct then why not help nature by reducing the number of trees of the original species to that necessary to sow up the area eventually? The trees thus left can be removed later, in, say, the 2nd period, when regeneration has taken place and the rotation extended by the necessary number of years. Moreover regeneration operations being concentrated perhaps a method will be found of hurrying up nature a little. It is certainly very unsatisfactory to find that regeneration does not follow fellings and not to know for certain the cause of failure or even if regeneration will eventually take place, but to scatter the fellings all over the forest and to delay indefinitely their completion in

any one place for this reason will merely prevent the discovery of the cause of, and possible remedy for, the failure.

Another objection which is raised to concentration in the Himalayan forests is the steepness of the slopes. I am inclined to think, however, that where the slopes are so steep as to make concentration an impossibility, the forests are not workable on commercial lines at all; that they are in fact merely protection forests, and that only by confining the fellings to the removal of dead trees can a more or less regular yield be obtained. Existing Working-plans being based on the removal of mature trees, it is possible that some forests have been treated as commercially workable whereas, judged by their incapacity to maintain the possibility assigned to them, they are not really so. When patches of well-stocked forest are comparatively easy ground, two or three acres or more in extent occur on a slope which consists largely of precipitous ground occupied by scattered tree growth, regeneration may be capable of being concentrated on these patches. The slopes in the Kaghan valley are very steep, but I did not see any commercially workable forests in which I should be afraid to concentrate fellings for this reason.

Finally it is argued that the very uneven age of the crops makes concentration impracticable on account of the financial loss in felling immature trees, and impossible because immature woods cannot be regenerated naturally. This is a difficulty which may perhaps be got over by refraining from felling patches of immature growth which will not be physically overmature after the lapse of another rotation. If this is done the rotation can be reduced below that which would ordinarily be adopted, thus bringing the mean age of the crop in the second rotation as near as possible to the correct age and the yield during the first rotation nearer the normal.

I do not wish to lay it down as an axiom that regeneration operations can under all circumstances be concentrated, those acquainted with local conditions must decide each case on its merits; but I do think that probably lack of appreciation of the importance of concentration (together with opposition to the

introduction of certain European systems) has led to the difficulties being overestimated; and if this article has the effect of getting more attention paid to the question my object will have been attained.

The greater part of this article was written several months ago, but I delayed completing it until I had seen certain forests worked on the Uniform System in the United Provinces. In the meantime I find that I have been anticipated in a good many of my remarks by Mr. Smythies in an article on *Pinus longifolia* in the November *Forester*. I am glad to see that we are in agreement on most points, but as he rightly points out I had recently written that the Forbach system of sylviculture, *i.e.*, the system which gives a free hand to the officer in charge and which both he and I now recommend, could not possibly be adopted under Indian conditions. My excuse for the apparent inconsistency is that I was thinking more of the general arrangements than of the actual marking when I wrote, and I have now modified my opinion in that I think the manner of marking can be left to the officer in charge provided certain safeguards are adopted such as—

Small compartments.

A carefully kept Forest Journal to assure continuity of action in spite of transfers.

Sequence of compartments to be operated on to be laid down at intervals.

M. R. K. JERRAM,
D. C. Forests.

SAL REGENERATION IN THE DUARS FORESTS.

Of late years it has become increasingly evident that sal regeneration is not establishing itself satisfactorily in these forests, and several Forest Officers have realised this with anxiety These forests produce some of the best sal timber in India, and from this source alone, revenue to the extent of about Rs. 4,00,000 was obtained last year in the Buxa and Jalpaiguri Divisions. We think it will do no harm to set down the facts so far as we know them at present, and even, tentatively, to draw some conclusions from them.

The types of forest in which sal is found may be classified as *Sal Savannahs*, *Dry sal forests*, *Wet sal forests*.

Sal *Savannahs* in the Duars consist of areas with a dense growth of grasses (chiefly *Saccharum* spp.) up to a height of 7—12 feet, with scattered trees of fire-resisting species, especially sal, kumbi (*Careya arborea*), tantri (*Dillenia pentagyna*), udal (*Sterculia villosa*), bahera (*Terminalia belerica*) and sidha (*Lagerstrœmia parviflora*); also mallata (*Macaranga* sp.) gregariously where fire-protection has been accomplished. These savannahs are normally burnt early every cold weather, unless fire-protected.

Dry sal forest is of general occurrence in burnt areas, and in fire protected areas on the slopes of the foot hills or on well drained sites in the plains, especially on high plateaux above streams. The overgrowth consists of the Savannah type trees as above, together with many others, among which perhaps the most important is sum or kaula (*Machilus* sp.). The undergrowth in areas annually burnt, or under the shade of mallata, varies from practically none to a moderately dense growth of shrubs, mainly deciduous up to a height of perhaps 10 feet. In unburnt areas without mallata, it is similar but much closer, with a few evergreen species beginning to make their appearance. *Milletia auriculata* and *Bridelia* spp. are perhaps the most characteristic shrubs in this type.

Wet sal forest is found in the rather lower lying places adjoining and merging with the dry. The overgrowth has sal and the deciduous fire-resisting species mentioned above, chiefly as old trees. There is also a second storey of evergreen trees, comprising many *Lauraceæ*, *Meliosma simplicifolia*, etc.; *Macaranga* is usually absent. The undergrowth consists typically of an almost impenetrable mass of shrubs and creepers matted together, the majority of which are evergreen, *Croton caudatus*, *Bridelia* spp., *Leea* spp. and scandent acacias being perhaps the most characteristic—the whole forming a dense tangle of some 5—8 feet high, but frequently raised in a sheet to a height of 15 feet or more by the efforts of shade-bearing trees to break through. Climbers, both herbaceous and woody, are at their worst

in this type, which does not exist outside fire-protected areas, owing, no doubt, to the drying influence of fires.

In well drained *savannahs*, where the density of the grass has been reduced, either by early fires, cutting of thatch, or by the shade of mallata, we nearly always get good sal reproduction which usually establishes itself; on the other hand, where the density of the grass remains intact, sal regeneration is entirely absent.

In *dry sal forest*, in burnt areas there is generally sufficient sal reproduction, and frequently, a dense crop of established seedlings, whereas in fire-protected areas it is rare to find a patch of successfully established sal, although seedlings are plentiful immediately after the seed fall.

In the *wet type*, established saplings or seedlings do not exist although, as before, yearling seedlings are of fairly common occurrence, especially on cleared lines and cart-tracks.

There is, unfortunately, every indication that the wet type is encroaching on the dry, owing, presumably, to successful fire-protection, in fact it would appear that when the present crop of sal has been exhausted, there will be no more to take its place. The first thing that strikes a forester returning after several years is the remarkable increase of evergreen undergrowth and the almost complete absence of sal between the seedling and pole stages under healthy seed-bearers. (One of us has recently returned to the Duars after an absence of 14 years.)

Conditions of management of these forests have greatly changed of recent years. The greater part of them have been under reservation for 30—40 years. Prior to that, and to a lesser degree for several years subsequently, fierce fires raged over all the savannahs, while fires of more moderate intensity ran through considerable areas of sal forest. Similar conditions may now be seen in forests outside the reserves in the adjoining Goalpara Division, and to a lesser extent in the Jalpaiguri district, though in the latter they are much modified by grazing. There was little restriction placed on fellings, but even where overfelling took place—as occurred on areas accessible to markets—a sufficiency of seed-bearers almost invariably escaped the axe. Climbers were left untouched and,

though greatly held in check by the almost annual fires, did considerable damage to the sal.

The opening of railways and roads, and an increased demand for forest produce from tea gardens naturally led to the more systematic working of the forests; and in 1896-97 and 1905 the Jalpaiguri and Buxa Working-plans respectively came into force. Both plans, as was natural in view of the damaged and charred appearance of the sal, laid the greatest possible stress on fire-protection, and with the greatest success, for fires are now of comparatively rare occurrence, and there is practically no savannah left inside the reserves, it having been replaced by tree forest.

It was hoped and expected that by eliminating fires and grass, there would be no difficulty in obtaining and maintaining perfect sal forests; unfortunately an entirely new and unforeseen condition arose in the shape of evergreen undergrowth producing a hitherto non-existent type of forest. The phenomenal increase in the growth of climbers resulting on the exclusion of fire was also not anticipated.

It was not long before these facts forced themselves upon the attention of Forest Officers. First, the increase of climbers—old enemies of sal forest—was noticed, and during the last decade comparatively successful efforts have been made to combat them.

Some seven or eight years ago the increasing density of the evergreen undergrowth began to attract attention and the first step in the shape of cleanings and weedings was taken. These were undertaken over a series of coupes for five consecutive years after felling, and were designed to free all sal advance growth until it became established. Even supposing that in some cases the work has not been properly carried out, recent examination of these coupes showed very poor results. Such seedlings as have survived to the end of the five years' period are by no means established and cleanings to assist them would apparently be necessary for a further indefinite period. To do this is impossible owing to the expense involved and the scarcity of labour.

The next suggestion put forward was to reduce the density of the herbaceous undergrowth by burning it, but in areas where this was most necessary it did not appear possible to make it burn, and forest officers were naturally averse to introducing fire where much care had been taken in the past to exclude it.

About the same time the known property of mallata as a nurse for sal drew attention to the possibilities of that tree as a solution.

The first actual experiments on the lines suggested by these observations were, we believe, made in Goalpara in the Raimana block in 1908-09 where areas of wet type were cleared of every thing but sal, part being burnt and part left. Owing to the repartition of Bengal and Assam we have not personally had the opportunity of following these experiments.

Experiments started in Buxa Division in 1911-12 are now being carried on to try to find out

(1) whether sal seedlings can be established artificially under mallata.

(2) and if so, whether mallata or savannah can be cheaply introduced in the place of evergreen undergrowth.

It is too early to draw any definite conclusion from them but at the same time, we have some indications of what the results will be in a few cases.

It may here be explained that mallata canopy is an extremely light one, consisting only of a sheet of leaves hardly touching one another and scarcely more than one leaf thick at a uniform height of 15 to 20 feet above the ground, with nothing but bare stems and branches underneath.

With regard to (1) there can be no reasonable doubt that under favourable conditions, at any rate, sal seedlings can establish themselves and eventually pierce a complete mallata canopy. An entirely successful example of this is to be seen in the Muraghat Reserve close to Kuntimari bungalow. The sal seedlings which have been under observation some five or six years are now making rapid progress, and have every appearance of being able to reach the sapling stage within the next five to ten years. It must,

however, be borne in mind, that the North Muraghat forest affords the best sample of successful sal regeneration to be found in these reserved forests. It has just passed the savannah stage, and it occupies chiefly well-defined undulations resulting in good surface drainage, the two main essentials for favourable sal regeneration in the Duars. It remains to be seen whether the sal will thrive equally well under mallata in forests which have reached an older stage. It is surprising that, if it is an infallible nurse to sal under all conditions, these forests should contain so few examples of sal thoroughly established in it. It may here be explained that by an established plant we mean one that is in a position to hold its own up to the pole stage without intervention.

With regard to (2), experiments at Mendabari where areas of dense *wet type sal* have been cleared of undergrowth and subsequently burnt over, show that here, at any rate, dense mallata can be substituted for the original undergrowth at about Rs. 4 per acre. A similar experiment at Rajabhatkhawa, where labour is more expensive, costing Rs. 6-8-0 per acre, has failed so far to introduce either mallata or savannah grass, owing, we think, to too much top cover having been left and to the fact that the cut jungle was stolen by surrounding villagers before burning, thereby reducing the intensity of the fire. A new area will be taken in hand this year in which these mistakes will be rectified. An experiment (also near Mendabari) of yearly burning of half square mile of dense wet type sal without cutting any undergrowth has, after two annual burnings, resulted in many places in a marked reduction of evergreen undergrowth with savannah grass beginning to make its appearance.

The fire which at first was started with difficulty from the dry jungle cut along the lines demarcating the plot, resulted in a very patchy burning and will certainly increase in intensity and area with each successive burning; as undergrowth killed by one fire becomes fuel for the next, and the increasing savannah grass will still further assist it. The cost of this experiment is, of course, very small.

Experiments in sowing mallata are in progress near Rajabhatkhawa, and show that broad-cast scattering of seed in evergreen undergrowth without cutting is a failure, as mallata must have light, and that sowings, after clearing the undergrowth, are only moderately successful, probably owing, as before, to too much top cover. A new experiment will be made this year. Such sowings are of course expensive.

It is known that under ordinary forest conditions, sal seedlings die back for a number of years and eventually form trees from their old root-stocks. It is perhaps not so generally known that sal seedlings in the Duars, under ideal conditions, not only develop straight from the seed, but that during the first two to three years their growth is extraordinarily rapid.

A seed-bed at Mendabari prepared in June 1911 in open country for the germination test contains saplings which have attained a height of 10 to 11 feet in 2½ years, the average height being about 7 feet. A similar seed-bed at Rajabhatkhawa made at the same time showed equally good results before it was dug up.

We may then briefly summarise as follows :—

That in the Duars, it appears evident that although seedlings may survive in a healthy condition for several years, their subsequent establishment is by no means assured. That, in fire-protected sal forests, there is an almost complete absence of sal between the seedling and the pole stage. That, in the Duars proper, *i.e.*, excluding the hill-slopes, sal regeneration only establishes itself in burnt savannahs. Therefore, although fire is very injurious to established sal, we think that it is indispensable to successfully establish it.

Further we believe that—with the reservation that it may be found practicable to establish sal with the help of mallata—the only successful means of regenerating these forests is by means of clear felling, leaving only the necessary seed-bearers, followed by successive annual burnings until savannah is formed and a sufficient number of seedlings have established themselves in it. These areas must then be carefully fire-protected and climbers cut. We believe that this method of treatment will produce a more or less even-aged crop of sal, similar to the clumps now found in savannahs.

The new Khoriarbandar reserve which was regularly burnt up to four or five years ago is a brilliant example of the establishment of sal forest brought about by conditions such as we propose to introduce.

We make these suggestions in all diffidence, for just as after combating fire, a new enemy in the shape of evergreen undergrowth has been introduced, so it is possible that we may again be faced by some unforeseen opponent, such as a fire-resisting undergrowth inimical to sal—say Galeri (*Leea crispa*) or wild mint.

J. W. A. GRIEVE,
Dy. Consr. of Forests.

E. O. SHEBBEARE,
Dy. Consr. of Forests.

A NEW EUPHORBIA.

The following has been sent us by Mr. Haines, Conservator of Forests:—

" **Euphorbia caducifolia,** *Haines.*

Euphorbia Diacanthii sectionis. Ab E. nivulia, *Ham.* et nereifolia, *L.* habitu omnino differt. Ab eis etiam foliorum involucrique loborum forma antherisque recedit. (E. nivuliæ antheræ obcordatæ oblique dehiscentes sunt. E. nereifoliæ antheræ oblongæ apiculatæ sunt.) Frutex caulibus ab radice multis strictis carnosis 1—1·5 m. altis et circa 3—3·5 cm. diametro, infra inermibus, supra tuberculatis. Tuberculi apice nigro spinis duabus stipularibus rectis 5—8 mm. longis instructi. Folia caducissima juventute late-ovata margine crispato. Involucra solitaria vel in cymas 3-natas breves disposita, lobi late rhomboideo-obovati fimbriati, glandulæ tumidæ transverse-oblongæ, bracteolæ interiores lineares alte fimbriatæ. Involucra lateralia bracteis oblongis obtusis mucronulatis suffulta. Antheræ late-oblongæ muticæ in longitudinem dehiscentes.

Found on the dry sandstone rocks of the Satpura Hills and in the Raipur district of the Central Provinces. "

EXTRACTS.

WOOD DISTILLATION IN INDIA AND AMERICA.

At a recent meeting of the Indian Board of Forestry, Mr. Lodge, Conservator of Forests, Western Circle, Madras, drew attention to the fact that the subject of the destructive distillation of wood was prominently before the Government of Madras some years ago, but that it was not considered the duty of the Forest Department to take the matter up, though it seemed unlikely that private enterprise would do so. Mr. Lodge pointed out, also, that all the acetone now required for the manufacture of cordite in India is imported, and at present India is entirely dependent on oversea countries for its supplies. He was convinced that a factory would pay handsomely, and suggested the formation of plantations of Eucalyptus, which species, especially when young, had been proved to yield large quantities of acetates. Mr. Hart (Central Provinces), with whom Mr. Pearson agreed, considered that for coniferous woods the methods described in the supplement to the *Scientific American* of December 7th, 1912, held out the greatest promise of success, as the quantity of the rosin turpentine yielded is said to be equal to that obtained by distilling exuded rosin. In this connection it was noted that

inquiries are now being made in America as to the possibility of utilising in this manner the twisted Chir pine which is now quite useless and which is found so abundantly in Almora. At the close of the discussion the following resolution was passed :— "That (1) in the opinion of the Board destructive distillation should find a place in the Economist's programme and that he should collect information as to the cost of bringing unsaleable wood, and possibly bamboos, to given centres, and as to the demand for, and current prices of, the various products and by-products of the process. The Board also suggests that if the information collected appears to offer a promise of commercial success, definite proposals should be placed before the Government of India for consideration as to the advisability of employing an expert to start the industry on a small scale; (2) when special inquiries into subjects of this kind, which are of general interest to the Forest Department, are undertaken in any province, the results should be communicated to the President of the Forest Research Institute, and to the Chief Conservator and Conservators of other provinces."

A recent Bulletin issued by the United States Department of Agriculture states that the most valuable by products of beech are obtained by distillation. Mention has been made of early beech charcoal. Methods much more effective and less wasteful are now employed in making this commodity, and a number of additional products are now extracted. Destructive distillation is to-day carried on with great success in large and costly plants. Beech, of course, is not the only wood put through the process, but it is one of the most important hardwoods, the others being birch and maple. In 1909, in the United States, 1,149,847 cords of hardwood were distilled. The kinds and quantities of the product were :—Charcoal, 53,075,102 bushels; crude alcohol, 4,468,083 gals.; gray acetate, 148,769,479 lbs.; brown acetate, 2,156,907 lbs.; iron acetate, 302,624 gals.; oils, 37,995 gals. An averaged cord of wood by this process of distillation yields :—Charcoal 46·16 bushels; crude alcohol, 7·37 gals; gray acetate, 129·39 lbs., brown acetate, 1·88 lbs.; iron acetate, 1 quart, oil, 1 gill. The

average cost of a cord of wood was $3·32, and the value of the product extracted was $6·65. These products enter into many arts and trades. Charcoal is used as fuel for home, bakery and shop, and in blast furnaces, in the manufacture of gunpowder, and for filtration in sugar refineries. Wood alcohol is a fuel, but its principal use is as a solvent in making varnishes and shellacs and in the manufacture of perfumery, dyes and commodities of a similar kind. The acetates are valuable for making wood vinegar, acetic acid, ether and acetone.—[*Oil and Colour Trades Journal.*]

THE FOREST OF DEAN.

INJUDICIOUS MANAGEMENT.

Situated near the western extremity of the county of Gloucester, the Crown Forest of Dean comprises much of the land lying in the angle formed by the junction of the rivers Wye and Severn, and has been in the hands of the State from the earliest times. Edward the Confessor is stated in the Doomsday Book to have exempted the Forest of Dean from taxation, manifesting an interest in its protection on the part of the Crown, to which, no doubt, it had now become annexed, and it was here that William I, while hunting, received the news that the Danes had invaded Yorkshire. That the district has been populated from the most remote past is evident from the fact that the mining of iron ore in the Forest was prosecuted even in pre-Roman times.

Though the area now in possession of the State is not so extensive as was formerly the case, the purchase of the estate of High Meadows ninety-five years ago has to a certain extent counterbalanced these losses, and at the present moment I believe some 22,000 acres are Government land. The altitude varies from 130 feet to 900 feet above sea-level, and the soil in most places is excellent—of a yellow loam, underlying which is sandstone. The number of acres actually under wood is 19,000, and of these 11,000 are enclosed. Between 600 and 700 acres are freehold lands of the Crown, freed from rights of commoners. Eleven thousand acres are entitled to be kept enclosed for growth of timber as against

rights of commoners, with exception of rights of free miners beneath the surface: while the land of which freehold is in the Crown, subject to claims of commoners, is 7,500 acres.

At the present moment the Forest is suffering from a somewhat injudicious management in former years. Oak is the predominant tree, and of it there are as much as 10,000 acres, owing to the value of its wood for naval construction up to recent years. The soil of the Forest is excellent for this valuable timber, but in every wood that I visited the trees were growing too widely apart for the best results to be obtained. Extremely heavy fellings took place in the plantations about the year 1850—the last great fall of naval timber took place in 1853—with the result that the remaining trees, being allowed too much space, developed large crowns and epicormic branches, while increasing but little in height. It is probable that if beech had been introduced as an undergrowth, this would largely have been prevented, but it is only recently that the possibilities of beech in this respect have been fully realised. Oak, as I have said, was formerly planted more extensively than any other tree, because of its uses in naval construction before the more recent ironclads superseded the old wooden men-o'-war, and it is stated that the Spanish Armada had strict orders to destroy the Forest of Dean immediately on landing in this country. It does not appear evident by what method the invaders were to set about the campaign of destruction, but the accounts which had probably reached them of the laying waste of the Scottish pine forests by fire may have led them to imagine that this method might be applied to the Forest of Dean also.

The tendency nowadays is all in favour of passing over valuable but slowly maturing trees such as oak for more rapidly growing conifers, such as larch, Douglas fir, or spruce. This is justifiable from the point of view of the private owner, though as the State never dies, this argument—of quick returns—does not hold here to the same extent. There are, as a matter of fact, in the forest about 150 acres of ground under a striking crop of naturally regenerated oak, which I imagine must be the finest example of its kind in the country, the young trees growing

strong and vigorous, and covering the ground thickly with few gaps. In the oak woods, even though the trees are far apart, the growth of the young oak seedlings is usually choked off after the second year by the bracken—which is here almost as troublesome as at Inverliever. The Forest of Dean does not, as a rule, suffer greatly from storms, but a violent gale in February 1662 prostrated 1,000 trees in the course of a single night.

There are few matured conifers in the Forest, but near the river Wye are some excellent larches about fifty years old. Near them is a larch, now standing by itself, which at five feet from the ground showed a circumference of 10 feet 2 in., and which contains about 180 feet of timber, though estimated as only 90 years old at the outside. Japanese larch have been introduced, though in no great numbers, and promise well. One which I saw in the nurseries had reached the surprising height of just on six feet during its first three years. Should the Japanese larch continue to do well, its immunity from disease will stand it in good stead, for the larch disease—*Dasycypha calicina*—is prevalent amongst the European larches in the Forest. Douglas firs have been introduced, their qualities of rapid growth and resistance to moderate shade rendering them useful in planting up partially-shaded gaps between older trees. A plantation of Weymouth pine—*Pinus strobus*—is doing well, and certain areas of the Corsican pine have been planted out, though this tree for some reason is not uniformly successful in the forest. I saw one plot of *Cupressus Lawsoniana*. There are a large number of collieries in the Forest, so a ready market is found for the smaller trees as pit-props. Larch and oak are specially valued for this use, while birch and, I am told, beech are looked upon with little favour, on account of their inability to last long under ground.

Charcoal is made in various parts of the woods from wood too small to be serviceable as props, and there has just been started in the centre of the Forest a factory for the manufacture of various products from this type of wood. The small logs are first heated above a furnace in an air-tight chamber until they have been converted into charcoal, while the volatile products of the wood

are expelled in the form of vapour through a large pipe. The tar—an easily liquifiable substance—is caught and drawn off at a certain stage of the process, while the pyroligneous acid and the naphtha, which requires a lower temperature to cause them to condense, are retained in a special apparatus at a greater distance from the furnace. The pyroligneous acid is later separated from the naphtha, and the latter now undergoes further purifications, although the finished product has, up to the present, persisted in retaining a faint colouration which is detrimental to its ready sale. In the last stage of the process the pyroligneous acid—or acetic acid, as it is perhaps more often called—is mixed with lime, and acetate of lime is formed. About 30 men are employed in these works, which are the most modern of their kind in this country, and which should have a successful future before them.

The Forest staff—that is, the men actually engaged in the Forest proper—is over 200 men. Under the deputy surveyor is a superintendent, and next come the three Crown keepers, having, roughly, 8 acres of pasture land along with their houses sufficient to keep, say, a couple of cows, a horse or perhaps two, and a small flock of sheep; also the Crown woodmen, who supervise the work of the forest labourers, have about two acres of pasture land. All these men sit rent-free. Some of the Forest workers reside in Crown dwellings, for which they pay a yearly rent of £4—about half what they would pay to a landlord—but only a certain number of Crown houses are available. I am told that a great many of the boys who start their working lives in the Forest are induced to go over to the collieries on account of the higher wages they can command there. There is, however, no difficulty in obtaining labour at any time

Wild life in the Forest is varied Here the red deer was in earlier times to be seen, but has now become extinct, and the fallow deer, formerly plentiful, has been reduced until nowadays no more than 20 to 30 remain. This decrease has been due largely to the number of beasts accounted for by poachers, who, owing presumably to the number of collieries in the district, were in considerable force. It is said that poachers of a primitive stamp

resorted to the expedient of dropping a heavy iron bar from where they had secreted themselves—on the projecting branch of an oak—so that it should fall across the neck of the unfortunate deer which had come to browse beneath. It is chronicled that they baited a large hook with an apple, and suspended it at the proper height by a stout cord over a deer path. They also set nooses of iron wire in a row, fastened to a rope secured to a couple of trees into which, aided by dogs, they drove the deer. Wild boars were numerous in the thirteenth century, and in 1226 Henry III granted to the Abbey of St. Peter, in Gloucester, a tithe of all the Forest boars. In certain parts of the Forest the badger is common, and the fox has his home in the thick covers. Mice do little damage; the kestrel takes heavy toll of their numbers, and that even the hated sparrow hawk has its useful side is brought home from the fact that in the Forest of Dean its prey consists largely of the wood pigeon, a bird more injurious to agriculture than any other in this country. The kite and the buzzard have long disappeared, but here the raven nested till the middle of the nineteenth century, before he, too, went the way of so many of our rarer birds.—[SETON GORDON IN THE *Scotsman.*]

BELLADONNA IN INDIA.

The following report has been received from the Economic Botanist to the Botanical Survey of India, to whom sun-dried roots of *Atropa Belladonna*, grown at the Kutchery garden, Naini Tal, were submitted :—

" . . . The roots consisted of two kinds, *viz.*, from one-year-old plants and from two-year-old plants, and were registered respectively No 34375 and No. 34376. The alkaloid was estimated in each sample of root and it was found to occur to the extent of 0·4 per cent. in that from the one-year-old plants and 0·45 per cent. in that from the two-year-old plants. Belladonna roots obtained from Europe and used in British medicinal preparation contains from ·2 to ·6 per cent of total alkaloids. The roots

grown in Naini Tal are therefore of good average quality and are suitable for use in the Medical Store Departments of India.'

Considering the fact that the soil in which these plants were grown cannot by any means be regarded as good, the report that the roots are of good average quality is most encouraging, and fully justifies the experiments being made on a more extensive scale.

In better soil, which is easily obtainable in the Ramgarh neighbourhood, I believe that far heavier yields and a considerably higher percentage of alkaloid will be obtained.

The Naini Tal results worked out as follows:—

Belladonna roots—1 year old ... 3,570 lbs. per acre (alkaloid 0·4 per cent).

Do. do. 2 year old ... 3,545 " " (alkaloid 0·45 per cent).

From the above it will be noticed that although the percentage of alkaloid was far greater in the two-year-old roots the quantity harvested was actually less. The reason for this I am unable at present to explain beyond the fact that it was probably due to the plants having been grown in poor soil.

A point that should not be lost sight of is the ease with which this drug can be grown and the imperviousness of the crop to insect pests and animal life. A good stock of acclimatized seed has been saved from both Naini Tal and Douglas Dale grown plants. The roots of the Douglas Dale grown plants rot during the rains, but seed, which is of a lighter colour than that produced in Naini Tal, has been saved.

Belladonna root is at present obtained from England by the Medical Stores Department at a cost of about four pence per pound, so that there is every prospect of Belladonna being grown profitably in Kumaun.—*The Tropical Agriculturist, from the Annual Reports, Kumaun Government Gardens.*]

TREES AS FOOD.

An excellent diet at no cost could be obtained from products in various parts of the world if all could be gathered together in one spot.

For instance, the Venezuelans have a tree which they have called the cow tree, because whenever the trunk is cut a stream of thick, creamy milk gushes out. Every morning and evening the natives come with bowls or pails and collect the milk from the cow trees. If allowed to settle the milk soon becomes cheese. The cut in the tree heals quickly, and the milk collects as before.

Closely akin to this is the butter tree in Central Africa. The kernels of the fruit of this tree yield butter, which can be preserved for a year or more.

The bread tree flourishes in the islands of the Pacific. Its fruit, when baked, resembles bread, and is eaten as such by the natives.

The water tree is found in Madagascar, and each stalk when punctured will yield a quart of pure, clean water which is most pleasant to the taste.

The candle tree provides the natives of the South Sea Islands with tallow.—[*Timber Trades Journal.*]

THE MOST VALUABLE FRUIT TREE IN THE WORLD.

An insurance policy against loss by fire or frost for £6,000 was effected on a pear tree—the most valuable in the world—owned by Mr. H. A. Woodworth, of Whittier, California, who last season realised £640 from its fruit.—[*Timber Trades Journal.*]

WOOD.

[By DANIEL WELLS, in the *American Lumberman.*]

We are constantly asked, "Are not concrete and steel replacing wood?" I could show you figures from now until to-morrow morning demonstrating, up and down and across, the increase

per capita in the use of all kinds of lumber. When you had finished these tabulations you would know in a kind of way that there was still a place for lumber. Why not answer the question yourself in a personal way?

Do you see any wood about you as you wend your way through an ordinary day's existence? In the morning you arise from a wooden bed, step to a wooden floor, dress from a wooden dresser, brush your hair with wooden back brushes. Yes, I know some of you get out of a solid brass bed, but not all, for I hear it stated as a fact that there are several wooden beds made each year. When finished dressing you walk through a wooden door over a wooden floor again, down wooden stairs (not all of us tread the marble) to the dining-room. You look in at the living-room grate as you pass by to see if any coals are left from that wood fire you enjoyed so last night.

WOODEN NEWSPAPERS.

As you pass through the hall you open your wooden front door, and there on the wooden doorstep you find what?—a morning paper made of nothing but spruce wood. This piece of dried pulp was, a few months before, part of a green tree growing on the edge of a purple lake in the depths of Northern Quebec. I forgot to remind you that you were walking on shoe leather tanned by extract of hemlock bark, hence your shoes also owe their existence to part of a green tree growing in a Pennsylvania or Michigan forest. I don't know how long ago; it depends upon the age of your shoes. So far you are served and groomed from your hair to your shoes with products of wood

YOUR DINING-ROOM.

Now with your wooden newspaper in hand you retrace your wood tanned steps through wood hall over wood floor, through wood doors, wending your wooden way through your wooden dining-room. Now look around you and tell me what you see. Are there any steel chairs or a concrete table? Not yet, Mr. Edison,

Thus far you have had so much wood around you it is almost pushed down your throat, and now you will get even that, for here comes the maid with your favourite breakfast food, which is said by some authorities to consist of mere sawdust. After breakfast, pride and wife permitting, you pick your teeth with a toothpick skilfully fashioned from a sliver of wood.

YOUR STREET CAR.

Now leaving the wooden regions of your home interior, you proceed to get down to business. As you noticed a little rain dripping from your cedar shingle roof, you have brought along your wooden handled umbrella. You step to the nearest corner, stop a wooden street car—yes, I know some of it is metal, but I came down in one this morning and saw a little wood myself. I say you stop your wooden street car, unless its motorman, too, is a wooden man and goes serenely past. Clambering upon a wooden platform you walk in over a wood grating floor, sit down and look out through a wood framed window. As you whiz along you notice a wooden Indian in front of a cigar store. As your glance travels around the car, nothing but more wooden newspapers stare at you from all directions. At the next corner a woman sits down beside you carrying a brown paper package. That brown paper a few months ago was part of a hemlock tree sheltering a family of joyful birds in Northern Wisconsin. Again looking out of the window you see a close friend of yours driving down in his auto, riding on wooden wheels, steering with a wooden wheel, speeding over a wooden pavement, unless he is held up by a policeman with a wooden club.

Your car in its route passes many concrete buildings in construction, which you note are using wooden frames to shape the concrete.

Descending from your car you pass by a department store where many wooden wagons on wooden wheels are taking on their morning loads of boxes, packages and bundles. Every last one of them is done up in products of wood—paper, boards, fibre, no matter what, all lately part of a growing tree.

THAT STEEL-AND-CONCRETE BUILDING.

You ascend to your office in an elevator which has a wooden floor. Arriving at your level of this steel-and-concrete office building, you pass through a wooden door again, hang your hat and coat in a wooden closet, sit down in a wooden chair, draw a wooden drawer out of a wooden desk, select a cigar from a wooden cigar-box. The cigar itself is probably rope. You remove a paper (wood) band, then light this cigar with a white pine match. Where is your concrete match, Mr. Edison? When your cigar is going good sit back and take a look around. I want to take up this concrete case a little further with you.

Every way you look in the room you stare at wood; you can't avoid it. Do you realise how short a while it has been since that mahogany desk before you—as a tree—harboured a family of chattering monkeys in a Central American jungle? A stack of morning mail awaits you on your desk. Those are all wooden envelopes inclosing wooden sheets of paper. Several hundred thousand trees have to be sacrificed to supply your city each morning with its wooden mail. During your work you pick up a red cedar pencil to make a notation here, and a wood-handled pen to write something there, and finish by using a wood blotter.

AS IT WAS.

Let's reminisce. On this site now occupied by your office building there stood, say first, simply trees with wolves prowling through. Then came the white man with the axe, and built thereon, entirely of wood, a log cabin; not even an iron nail was used in its construction. Other people ventured through from the East to this frontier outpost The log cabin became a two-storey frame house and store. Business prospered—the place grew—the frame house was replaced by a more pretentious one of brick walls, joists, sills, etc. This was later enlarged, carried up two or three floors more, and stood for many years until a million-dollar company was formed to erect your present steel-and-concrete twenty-storey office building.

And do you appreciate there is probably more wood of various kinds used to-day in the office building, built, politely speaking, of that material called steel-and-concrete—using every square foot of space—than was formerly used in the three or four-storey edifice, where everything was wood but the walls? For every lineal foot of concrete in your building, or in any other, there was needed a lineal foot of lumber for the forms. And this lumber cannot be of the lowest grade; it must be of fairly good quality. Neither can it be used over again very much for these forms, as it becomes rapidly broken up through repeated use and handling. Lucky it is that substitutes have been found for wood, as there is not half enough to go round.

You finally end your morning's work by going out and taking a cocktail before lunch over a wooden bar, at your favourite club or café. There was a time when wooden nutmegs in various drinks were served over the bars, and wherever else they were used, but this is one of the kinds of wood that appear to have disappeared.

EVEN THE FANS.

In the afternoon you go to the ball game. See nearly everyone around you smoking cigarettes with wooden cork tips. Sit on a wooden bench and see the game lost or won, and your favourite player make a fool or a hero of himself, all with a wooden bat. As you sit on the wooden bench at the game you fan yourself with a paper (wooden) fan with a wooden handle. Where would the great American baseball passion be but for a stick of wood? Could it exist? Where would Roosevelt have been but for his Big Stick which he indiscriminately used for years, breaking heads and policies and battering at the wooden doors of Congress?

Thus you have made a pretty fair start in your day's work by the use of wood. You need a little of it yet. The change from wood to steel has nowhere been more pronounced than in shipbuilding. In the days of wooden hulls the exception of iron used to be rare enough to call forth a nickname such as "Old Ironsides." Now "Old Ironsides" and its wooden friends look the

size of a bug beside our thousand-foot "Imperators" One *wooden deck of such a modern monstrosity must contain more* wood than the hull of those arks of the eighteenth century. To-day's flagpole is as large as yesterday's mast. Then think of the hundreds of rooms of all sorts on a modern floating village, housing wood furniture, interior trim, etc., without end.

Don't pore over statistics! Don't go to the encyclopædia! *Just think it out for yourself. Multiply your case by 90,000,000,* and the result will be some of the wood used in the land. This is a concrete expression of what we feel about wood.—(*Timber Trades Journal.*)

THE IGNITION OF WOOD.

The substance the most employed to prevent the ignition of wood is silicate of potassium in solution; the wood is soaked in it, which protects it for a long time from all danger of inflammability. But several successive layers are necessary in order to arrive at a really efficacious immunisation. The following is a good recipe: Thirty-five per cent of silicate of potassium, 35 per cent. of sulphate of baryta, from 1 to 2 per cent. of zinc white, and lastly 28 per cent. of water; but it is not the only recipe. The greater number, however, are trade secrets. M. Wolff considers of great importance the impregnation of the wood with alum in order to render it incombustible; this process, however, does not appear to be in use. It was, indeed, noticed that during the fire of the alum manufactory of Muskan the fire spared all the beams that had long been exposed to the vapours of alum.—*Chemical News.*—[*Scientific American.*]

DWARF PLANTS AND MONSTROUS FLOWERS.

M. J. A. Urbain, Professor of Chemistry at the Sorbonne, has had the idea of making seeds germinate after having deprived them of their albumen. Thus, by his own will, he obtains monstrous vegetables. His work is returned in a paper read before the Academy of Sciences by the eminent Professor of Botany, M.

Gaston Bonnier. Evidently the albumen of a seed is not its essential part; albumen is only an alimentary reserve destined to feed the young plant until its radicle has become strong enough to seek for its food itself. But can the young plant do without this alimentary reserve? M. J. A Urbain shows that, if put to the test, it can do so, but not without suffering from the privation. M. Urbain's experiments have been made with seeds of the Palma Christi, the poppy, etc. These seeds deprived of their albumen germinated like normal seeds, but produced dwarf, stunted plants with modified leaves and often monstrous deformed flowers. This research of M. Urbain goes to prove the possibility of creating monstrous plants at will.

In the same way the late Camille Daresle produced, at will, monstrous chicken by interfering with the normal evolution of the egg, either by varnishing a part of its surface, or by exposing it to a too strong heat.—*Chemical News*.—[*Scientific American*]

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TEAK IN THE WYNAAD . A STUDY.

PART I.*

A.—PHYSIOGRAPHY.

The "Wynaad" lies geographically on the western edge of the great central plateau of the Madras Presidency, commonly called the Mysore Plateau, but belongs politically to the Malabar district. It lies about latitude 11° 45′ N. It is situated between the crest of the Western Ghats and the State of Mysore.

The *altitude* varies between 2,200 and 6,000 feet, the general average being 2,500 feet or a little less.

The *rainfall* rises from 60 to 70 inches on the east to as much as 400 inches or more on the crest of the Western Ghats—(*vide* also D. below).

The country is a chaotic welter of hills and consequently all *aspects* are represented.

There are three seasonal *winds*, namely, the south-west monsoon, the north-east and a blighting dry wind of great velocity

* This will be published in three parts.—(HON. ED.)

from the east during the months of February, March and April Apart from its evil effects in drying up the vegetation and the surface soil, the aerial denudation caused by this east wind is very great and forms a factor which will have to be seriously reckoned with sylviculturally.

The *soil* falls under two main classes, black or yellow tenacious clay and a hard, red clay soil mixed with gravel of a quartzite nature. Both these classes of soil have two factors in common. They are devoid of lime, and they are of great depth. As an example of the depth of the soil, it may be mentioned that elephants have been captured in pits nearly every year during the course of the past thirty years. These pits are 12 feet deep and have been constantly shifted from one place to another according as the elephants have changed their routes of migration. Yet never once has there been any difficulty in sinking the pits to the desired depth nor has rock ever caused a change of programme in the pre-arranged location of the pits. The poverty of lime is of interest, since both rosewood and teak actually store lime nodules in their tissues and these two species grow to perfection in the Wynaad. *Terminalia tomentosa* too is a lime storer and this is another tree which is seen at its best in this locality.

B—*THE GENERAL SITUATION.*

2. The Wynaad forms a Taluk of Malabar district. It is a "planting district." The estates or gardens have lain most thickly in the south of the Taluk, which has given rise to a differentiation into North and South Wynaad. In this southern portion of the Taluk, therefore, the vegetation *qua* forest has given place to valuable growth of other descriptions, principally tea. North Wynaad, some thirty years ago, also contained a number of coffee estates. But the failure of coffee caused this part of the country to be abandoned; now, however, tea is being introduced in the North, and there seems every likelihood that all suitable land in the Wynaad, both North and South, will in the course of a few years come under tea. Another economic factor of outstanding importance lies in the fact that the Wynaad (together with

Coorg) forms the head-waters of the Cauvery river on which depends the famous Mysore electric system, the Mysore Water Storage Project (now in process of development), the British Water Storage Project and the irrigation of very large tracts in British Territory. There is fortunately plenty of room both for tea and for head-water protection There is, however, a third factor to be considered, which very much complicates the whole situation. The indigenous population is still in the "shifting cultivation" stage of civilisation and the damage done to vegetation soil and water sources is at present very great. There are thus, on the one hand, the two great denuding agencies (as caused by man), tea and shifting cultivation, and, on the other hand, the urgent necessity of protection of the head-waters of a river of great economic importance. The Shifting cultivation must be gradually stopped, the Tea must be developed and the Head Water streams must be brought under very strict control.

The problem of hold'ng the balance between these conflicting tendencies, so that no one of them may deleteriously clash with the others, presents a situation of great nicety and one which will call for the utmost vigilance on the part of the Madras Government.

C.—THE ECONOMIC CONDITIONS AFFECTING TEAK.

3. So much for the general position. Turning now to the teak in particular, an examination of the past history of the Wynaad has shown that the occurrence of teak has been governed in the past and present and will be governed in the future by two prime agencies. These agencies are—the hand of man and the locality.

4. Take first the locality. In this latitude, it is found that the distribution of the teak is dependent on the altitude and the rainfall : and these are the ultimate factors which determine where the trees shall grow.

With regard to the altitude, teak is found to be practically non-existent above 3,300 feet. The local limits of this tree thus

lie between 2,200 and 3,300 feet. In point of fact, this limit covers most of the ground For although individual peaks rise to so high as 5,000 and even 6,000 feet, the total area occupied by such deviations from the average is small.

The sylvicultural importance of rain-gauges has not yet received that attention from the department which it deserves. Thanks, however, to the value which all planters attach to this instrument and to the fact that there are so many estates in the Wynaad, it is possible to assert with some confidence that teak (in the latitude and altitude * in question) is unable to bear more than 140 inches of rain, or somewhat less.

In this connection, it may be of interest to record the fact that, under the same conditions, *Bambusa arundinacea* disappears with much the same rain maximum. The teak and bamboo therefore resemble each other in this respect.

5. The next consideration is the hand of man. Here there are the three agencies of the tea estates......shifting cultivation and the lumbering operations of the past (*i.e.*, the period previous to the constitution of State forests) on both public and private lands.

Speaking generally, tea cultivation demands the denudation of all other growth. Any balance areas not under tea, belonging to any estate, will be wisely devoted by the tea owners to fuel supply for their factories, cooly lines, etc.

Shifting cultivation demands the spoliation of all vegetation. It is true that the type of man who practises this wasteful method of raising field crops spares all trees which from their hardness are difficult to cut. But teak does not fall under this category.

The lumbering operations of the past, both in private and Government lands, have for the most part aimed at the teak, and on private lands no teak tree, which is worth cutting, has any

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* (Note the proviso of altitude. In the same latitude but at a much lower altitude teak will not only grow but flourish in a rainfall of more than 200 inches.—F. F.)

chance of escape in the present. In fact outside the State forests so few teak trees can now be found that they may be eliminated from discussion.

6 Hence it is safe to conclude that, in future, the State forests will be the only places left in the whole Wynaad from which teak will not have been exterminated. But even in the State forests, there are large areas which had been seriously denuded before reservation stepped in: these areas will require rest and help for many years to come, before merchantable teak becomes again available.

Superficially, the existing position may be summed up as follows:—

Wynaad (area)	...	525,568 acres.
State forests	...	133,558·64 ,,
Present teak zone (producing merchantable teak)	...	64,000 ,,

A scheme for head-water protection is being evolved, and the decision with regard to this must rest ultimately with the Madras Government. In any case, this scheme will mostly lie beyond the natural teak limit So the ultimate area, where teak may be expected to be grown in the Wynaad, will cover somewhat less than 130,000 acres or about 200 square miles.

D.—ADMINISTRATION.

7. The State forests have been principally formed from the "Chenat Nair Escheat." The Chenat Nair was a man who was temporarily frothed up as a result of the (local) chaos which ensued on the downfall of Tippu Sultan. After being taken over by the British, the area was placed under "Conservancy" about 1865 and came under the Madras Forest Act at periods between the years 1884 and 1900. Fortunately the locality was and still is very inacessible or all the forests would have been denuded of their valuable teak. As it is, merchantable teak has temporarily been wiped out along the Mysore and Nilgiri frontiers. So thoroughly has this been the case, that it will be another sixty years before the teak in this region can again be worked.

8. Administratively, the forests are divided into two ranges known as Begur and Chedleth respectively. Arboreally, the ranges are very similar except that Begur contains no *Shorea Talura*. Physically the rainfall of Begur in the teak zone averages 130 inches, while that of Chedleth is about 80 to 90 inches. But Chedleth with a lesser total rainfall receives nearly double the quantity of rain in the months of April, May and June than Begur does. This difference in the rain distribution forms a very material factor of the situation. Although the nature of the growing stock is much the same, this difference in the total rainfall will have an important result. Apart from the teak, Begur will tend to become more and more a rosewood range, while Chedleth in its drier portions will become a *Shorea Talura* range.

Roughly, Chedleth may be regarded as being composed of Wet Mixed Deciduous Forest and Begur of Very Wet Mixed Deciduous.

9. Conformably with the Government of India Circular, the forests of the Wynaad fall under the two categories of Head-Water Protection Forests and Commercial Forests.

10. So far not much has been said about teak. But it is always well before dealing with any special factors of a problem to be clear as to what constitute the main issues. The whole is greater than the part. If the main issue is clearly grasped, then both whole and part can be intelligently co-ordinated.

Sylviculturally also it is necessary to deal generally with the existent conditions. The Factors of the locality differ so enormously throughout India, that a common interest in any one locality or useful comparisons between one locality and another become quite impossible, unless the circumstances governing each locality are known.

E.—GENERAL CHARACTER OF THE GROWING STOCK.

11. The forests in question are among the richest in the Madras Presidency, though such a statement by itself is quite useless. In order to gain an idea of the nature of the more abundant species which constitute the growing stock and the percentage in

which they occur (as taken over the whole of the two ranges) the following table is appended :—

Table I.—General Character of the Growing Stock.

No.	Name of tree.	Percentage of occurrence.	
		Begur Range, 130 inches.	Chedleth Range, 80—90 inches.
1	*Bambusa arundinacea*	32·27	13·39
2	*Terminalia tomentosa*	14·74	13·21
3	*Grewia tiliæfolia*	6·01	6·41
4	*Dalbergia latifolia*	5·31	2·50
5	*Tectona grandis*	4·76	7·03
6	*Lagerstræmia lanceolata*	3·63	2·33
7	*Pterocarpus Marsupium*	3·63	3·81
8	*Phyllanthus Emblica*	3·52	3·09
9	*Kydia calycina*	3·17	7·18
10	*Randia dumetorum*	2·40	2·52
11	*Schleichera trijuga*	2·31	1·13
12	*Albizzia odoratissima*	1·91	0·19
13	*Terminalia belerica*	1·86	1·48
14	*Alstonia scholaris*	1·84	0·05
15	*Anogeissus latifolia*	1·18	6·75
16	*Stereospermum suaveolens*	1·11	0·46
17	*Cassia Fistula*	·99	1·62
18	*Adina cordifolia*	0·92	1·19
19	*Bombax malabaricum*	0·81	0·85
20	*Olea dioica*	0·74	0·57
21	*Eugenia Jambolana*	0·60	0·53
22	*Gmelina arborea*	0·57	0·47
23	*Bridelia retusa*	0·56	1·15

Table I.—General Character of the Growing Stock—(concld.).

No.	Name of tree.	Percentage of occurrence.	
		Begur Range, 130 inches.	Chedleth Range, 80—90 inches.
24	*Zizyphus Xylopyrus*	0·27	2·28
25	*Shorea Talura*	...	2·19
26	*Hopea parviflora*	...	2·14
27	*Erythrina indica* } *Eriodendron anfractuosum* }	0·12	1·27
28	*Odina Wodier*	0·05	0·76
29	*Myristica attenuata*	0·21	0·64
30	*Mangifera indica*	0·32	0·61
		and 105 other tree or shrub species 57·21	and 110 other tree or shrub species 45·21
		100·00	100·00

Here we have two series of forests side by side growing under very similar conditions, except that of rainfall, and may observe that with the increase in the rainfall —

(*a*) Numbers 1, 4, 11, 12, 14, 16 increase in abundance, but that

(*b*) Numbers 5, 9, 15, 17, 23, 24, 25, 28 decrease.

(*c*) Also that the following valuable trees (which are commonly found in very much drier districts than Malabar) are very rain hardy: —*Terminalia tomentosa*, teak, *Dalbergia latifolia*, *Pterocarpus Marsupium*, *Albizzia odoratissima*, *Anogeissus latifolia*, *Bombax malabaricum*, *Gmelina arborea*, *Eugenia Jambolana*, *Schleichera trijuga*, *Mangifera indica*.

12. The composition of the growing stock is being arrived at as follows. When the statistical inquisition of the district was commenced 5½ years ago, one of the problems to be solved was

that of utilising the services of the Guards. It was decided to entrust them with the compilation of the associates of the chief timber trees of the district and 19 of such trees were selected in these two ranges (Begur and Chedleth). For this purpose, every literate Guard—and the majority are literate—was given two of the commoner species growing in his beat, as his share of the work. All that the Guard is required to do is to stand with his back to each tree for which the associates are required and write down the names of all other surrounding trees which he can see in the forest as he moves round his tree. To meet the objection that many of the names of the trees in the forest are unknown to the Guards, each man is required to take a Kurumber or a Kurichiyar (local forest tribesman) with him to call out the names of the surrounding trees. The tribesman, therefore, acts as the enumerator and the Guard as the booker. It is impressed on each Guard that he must choose his trees at sufficient distances apart from each other, so as to evenly cover his beat. Two such lists of associates (one for each of the species allotted to him), have to be prepared by each Guard every week. The length of the lists naturally vary considerably according to—

(*a*) the density of the growth in different parts of each beat

(*b*) the season of the year in which the list is made.

When a sufficient number of lists have been received from each Guard, all the lists of each species are thrown together, in the District Office, into one amalgamated list for that species and the number and percentage of occurrence of the associates of that species is calculated. Further, by adding and throwing together all the lists for all the species (for which the associates are required) in each range, a general list for the range and a percentage of all the growing stock is obtained. The results as gained up to date are thus presented in the foregoing table. Each individual weekly list is no doubt inaccurate and some Guards do the work better than others, but from the Law of Averages it is clear that it is only a question of obtaining a sufficient number of these lists in order to arrive at a very fair approximation of the general state of the growing stock. In fact, such a result will

soon be obtained. For it is found already that the latest compilation has differed but little from the last preceding general compilation so far as the commoner trees are concerned. The nature of the work is quite within the competence of any Guard, and in this manner the services of the Guards are being utilised to arrive at a very important result It has been found also that Guards appreciate being given this responsibility and that some of them take a greater interest in their work in other respects. Besides this nearly all the Guards are really beginning to know the names of the trees in their charge—which in itself is no small achievement.

Taking a bamboo clump as a single stem, 251, 203 stems (of trees and bamboo clumps) have been listed up to date in these two ranges.

The preponderance of bamboo growth is noticeable. The only explanation which is forthcoming at present lies in the fact that a bamboo clump catches the eye more readily than is the case with individual trees and can be seen to a greater distance. They also hide trees which may happen to stand behind them. It is probable, therefore, that a greater number of bamboo clumps has been included in the countings than is warranted by their actual numbers on the ground. It is worth mentioning that the bamboos in both ranges have been flowering during the past four years, *i.e.*, Chedleth in 1910, 1911, 1912 and in Begur 1911, 1912, 1913. This has been a gregarious flowering and an ordinary lay observer would say (as they have said and are saying), that all the bamboos have flowered. This has not by any means been the real facts of the case, and many bamboos, both in isolated clumps and in isolated groups of considerable extent, have refused to join the majority in this flowering period

F. -DENSITY OF THE GROWING STOCK.

13. For practical purposes, it is not sufficient to know the growing stock and its percentage of occurrences. It is necessary also to know the average number of stems per acre. This information is being obtained by means of acre countings.

The figure arrived at so far for the number of stems per acre of one foot diameter and over, including bamboo clump, is:—

Table II.—Stems per acre.

Begur Range	44·07
Chedleth Range	79·50

At first sight, these figures do not indicate any very great density of growth. But it must be remembered that the bamboo clumps grow to an enormous size in this locality and develop a far-reaching sweep: Begur contains a much larger percentage of bamboos than is the case in Chedleth.

This portion of the statistics is being prepared by the Deputy Rangers and Foresters who each make one acre counting every week, as this work is considered too elaborate to trust, as yet, to the Guards. The figures given above cannot be accepted as finally correct, for there are many sources of error. For example, the laying out of an acre on the ground in heavy forest with thick undergrowth, the counting of the stems and the size of the stem. The object aimed at has been to enumerate only those stems of one foot diameter and upwards. As there is no time to put a calliper on every individual stem, the eye estimates of each man are liable to error in estimating whether stems are of about one foot, and wrongly to include or exclude such stems when preparing their lists. A great many more countings will have to be made before a practical accuracy is attained.

Even when a fairly correct figure has been secured, the factor will only be reliable for estimating large areas. The average size of a timber Coupe in North Malabar is 500 acres, and for this area the factor when obtained should give reliable results. For purposes of comparison, the trees in Begur are by actual measurements larger than those of Chedleth, and to this extent the value of the two figures 44 and 80 (stems per acre) is confirmed. Begur Range is richer also in bamboo growth than Chedleth.

G.—NATURE OF THE GROWING STOCK IN THE TEAK ZONE.

14. Table I, as presented above, includes the trees found in all the beats of the two ranges, whether they lie in the teak

zone or not. Some portions indeed consist of nearly pure bamboo jungle.

In order to ascertain the growing stock in the merchantable teak zone, instead of taking the results of the general compilation, only the lists of those Guards whose beats lie within the merchantable teak zone are compiled. The result of this more specialised compilation is given below.

Table III.—Growing Stock in the Teak Zone

Serial No.	Botanical name	Percentage of growth in — Begur Range, 130 inches.	Chedleth Range, 80—90 inches
1	*Bambusa arundinacea*	20·36	7·40
2	*Terminalia tomentosa*	10·87	14·84
3	*Grewia tiliæfolia*	8·43	7·20
4	*Tectona grandis*	7·62	8·52
5	*Dalbergia latifolia*	5·79	1·57
6	*Pterocarpus Marsupium*	5·45	1·16
7	*Kydia calycina*	5·13	8·97
8	*Lagerstrœmia lanceolata*	4·23	2·28
9	*Anogeissus latifolia*	3·51	8·56
10	*Randia dumetorum*	2·64	2·69
11	*Schleichera trijuga*	2·49	0·92
12	*Phyllanthus Emblica*	2·34	2·92
13	*Terminalia belerica*	1·91	2·02
14	*Albizzia odoratissima*	1·86	1·26
15	*Adina cordifolia*	1·73	0·86
16	*Alstonia scholaris*	1·65	...
17	*Cassia Fistula*	1·48	1·31
18	*Stereospermum suaveolens*	1·33	1·11
19	*Bombax malabaricum*	1·26	0·54

Table III.—Growing Stock in the Teak Zone.—(concld.).

Serial No.	Botanical name.	PERCENTAGE OF GROWTH IN— Begur Range, 130 inches	Chedleth Range, 80—90 inches.
20	*Albizzia Lebbek*	1 09	0·08
21	*Gmelina arborea*	1 00	0 56
22	*Myristica attenuata*	0·89	0·81
23	*Bridelia retusa*	0 84	1·37
24	*Ormosia travancorica*	0 70	...
25	*Olea dioica*	0·53	0 71
26	*Butea frondosa*	0·41	1·27
27	*Zizyphus Xylopyrus*	0·41	2·39
28	*Shorea talura*	..	4·26
29	*Erythrina indica*	0·40	3·12
30	*Odina Wodier*	0 09	0·73
		and	and
		39 other tree and shrub species 3 56	34 other tree and shrub species 10·57
		100·00	100·00

This percentage table of teak associates is manifestly not so accurate as the general percentage table. The number of Guards engaged in the compilation is less and the number of lists compiled is much fewer. Hence, a good deal longer time will be required in this case before the desired accuracy is attained.

The actual names of the associated trees are fairly correct, and it is noteworthy how many fewer species are found growing with the teak than in the general list of each range. Subject to the limitations of the results arrived at, this proves how varied

the different portions of mixed forests are, although to a casual glance the variations may not be very apparent. The table bears out the important proposition that the more intensive a working-plan is intended to be, the smaller area must it embrace—quite apart from any considerations as to the strength of the establishment sanctioned to carry out the plan.

The record also points to the danger of relying upon small square or rectangular sample plots when it is desired to arrive at the contents of any large area of mixed forest.

II—ASSOCIATES OF TEAK IN INDIVIDUAL LOCALITIES.

15. No associate lists of teak will be complete without ascertaining how the associates vary between one place and another in the same common area. In a locality where the variations of the rock formation are considerable, it would be advisable, as a beginning, to plot a soil map and ascertain the associates in different parts of each typical soil group. In North Malabar where the rock (gneiss) is so homogeneous and the soil is so deep, the soil variations are not so easy to differentiate. A rough beginning has been made by comparing the associate list in one beat with that of another, in the hope that further development may lead to a more skilful differentiation later on.

The annexed table (which includes only 29 species, the remainder being omitted as unnecessary for comparison) compares the associates of four beats. As these results are compiled from the lists of only the one Guard in the beat, it is evident that a very much longer time will be required to secure a sufficient number of lists before any true deductions can be drawn from them. All things must have a beginning, however, and the table as it stands is not without value.

Table IV.—Associates of Teak in Individual Localities.

Serial No.	Botanical name.	Begur Range. I Tholpatti per cent.	Begur Range. II Begur per cent.	Begur Range. III Bavali per cent.	Chedleth Range IV Kurichiyat per cent.
1	*Bambusa arundinacea* ..	17·46	21·40	18·43	17·45
2	*Terminalia tomentosa* ..	11·46	12·07	8·92	13·85
3	*Grewia tiliæfolia* ..	10·14	7·86	7·64	8·93
4	*Kydia calycina* ...	8·50	7·23	3·46	10·73
5	*Tectona grandis* ..	8·25	9·76	7·86	11·39
6	*Lagerstrœmia lanceolata* ...	6·25	6·44	6·47	3·52
7	*Anogeissus latifolia* ...	4·54	2·73	1·44	4·42
8	*Pterocarpus Marsupium* ..	5·48	5·06	4·41	2·62
9	*Dalbergia latifolia* ...	4·15	7·33	7·07	3·03
10	*Terminalia belerica* ..	2·03	1·64	2·78	...
11	*Albizzia odoratissima* ..	2·00	1·12	1·31	0·40
12	*Bombax malabaricum* ...	1·69	0·98	1·40	0·65
13	*Alstonia scholaris* ...	1·67	1·74	3·20	...
14	*Randia dumetorum* ..	1·58	2·07	2·78	3·19
15	*Cassia Fistula* ..	1·50	1·51	0·89	2·37
16	*Stereospermum suaveolens*	1·27	1·87	1·93	0·16
17	*Schleichera trijuga* ...	1·25	1·15	2·33	1·72
18	*Phyllanthus Emblica* ...	0·88	0·72	2·82	0·90
19	*Gmelina arborea* * ...	0·87	1·25	0·85	0·49
20	*Adina cordifolia* ...	0·87	0·36	3·93	...
21	*Olea dioica* ...	0·85	0·36	0·04	1·55
22	*Bridelia retusa* ...	0·71	0·69	1·74	0·16
23	*Zizyphus Xylopyrus* ..	0·61	0·13	...	4·50

* It is probable that *Mallotus alba* has sometimes been included with *Gmelina arborea* as the two species are very much alike when viewed from a distance.

Table IV.—Associates of Teak in Individual Localities—(concld.).

Serial No.	Botanical name.	Begur Range.			Chedleth Range.
		I Tholpatti per cent.	II Begur per cent.	III Bavali per cent.	IV Karichiyat per cent.
24	*Butea frondosa* .	0·46	0·33	0·02	0·65
25	*Wrightia tinctoria* ..	0·43	1·31	...	...
26	*Eugenia Jambolana* ..	0·42	0·13	1·23	...
27	*Albizzia Lebbek* ...	0·35	0·36	2·95	0·32
28	*Odina Wodier*	0·33	...	..	1·47
29	*Ormosia travancorica* ...	0·05	..	2·29	0·24
	Balance of other species ...	4·95	2·40	1·81	5·39
		100·00	100·00	100·00	100·00

I, II and III represent types of Very Wet Deciduous Forest and No. IV as a type of Wet Deciduous Forest.

I and II are better forest than III.

It is dangerous as yet to draw any but tentative conclusions. With this proviso, it will be observed that in types Nos. I and II, Nos. 4, 7, 15, 21, 23, 25 occur in a greater proportion than in type III; while in type III Nos. 13, 17, 18, 20, 22, 26, 27, 29 have a higher ratio than in types I and II.

In type IV, 4, 15, 21, 23, 24, 28 occur in greater frequency than in the other three types.

Lastly in types I, II and IV, we find a common predominance of 2, 4, 7, 15, 21, 23, 24 over the ratio in type III.

16. With regard to the question of natural reproduction by seedlings it is a matter of great importance to ascertain which associates of teak are to be considered desirable ones and which are not. When this knowledge is available, it will then be possible to watch whether the most desirable associates are gaining ground or otherwise. From this standpoint, it is more necessary to concentrate attention on the more lowly vegetation than the

high tree species. For the lowly growth responds more quickly to soil changes than the tree growth does, and the time necessary to watch individual areas is thereby shortened and our aim the sooner reached. In other words, where a forest is under real fire-protection, the soil is continually improving. With this improvement, certain species (especially of the undergrowth) will increase and oust other species. As soon as we know which of these species (whose conditions approximate to the conditions required for the reproduction of teak by seedlings) are commencing to thrive and increase, we shall be able to concentrate all the help we can afford the teak to the places where these species are increasing. By this means we shal. be utilising our money and resources to their full value and with real knowledge as to what we are about instead of frittering them haphazard in the forest without acting on any sure premises. In the one case we shall secure results, in the other case we shall continue, as is too often the case now, to illustrate the adage *Quot homines tot sententiæ.*

I.—UNDERGROWTH ASSOCIATED WITH TEAK.

17. Consequently as a subject closely complementary to the study of the trees found associated with teak, importance must be attached to the undergrowth found in the teak zone. Among some 80—90 species listed (and excluding all grasses) the following is a fairly comprehensive list of the commoner sorts and they occur in both the ranges.

Table V.—The commoner species forming the undergrowth which are associated with teak.

Acacia pennata.	*Jasminum Sambac.*
Do. Intsia.	*Thunbergia fragrans.*
Do concinna.	*Ipomaea coccinea.*
Crotolaria verrucosa.	*Argyreia cuneata.*
Do. laevigata.	*Stachytarpheta indica.*
Do. fulva.	*Phyllanthus niruri.*
Dalbergia lanceolaria	*Sterculia villosa.*
Desmodium umbellatum.	*Zizyphus Xylopyrus.*
Do gyrans.	*Do. Œnoplia.*
Do. triquetrum.	*Do. rugosa*

Table V.—The commoner species forming the undergrowth which are associated with teak—concld.

Ardisia humilis	*Urena sinuata*
Helicteres Isora.	*Indigofera pulchella.*
Leea sambucina.	*Gloriosa superba.*
Limonia acidissima	*Curcuma angustifolia.*
Murraya exotica	*Do. aromatica.*
Do. koenigii	*Do. longa.*
Clerodendron serratum.	*Costus speciosus.*
Mussaenda frondosa.	Other Scitamineous species.
Lantana aculeata	*Arisaema Leschenaultii.*
Solanum torvum.	*Colocasia Antiquorum*
Thespesia Lampas.	*Sauromatum guttatum.*
Triumfetta rhomboidea.	*Callicarpa lanata.*
Urena lobata.	*Vernon* 3 spp.

No theories as regards the relations of the undergrowth to soil qualities have yet been formulated, and from this special point of view, the homogeneity of the soil formation throughout the area is unfortunate and will add to the difficulty of this branch of the subject. A close study of the undergrowth will be important not only on this account, but also as to its effect on the surface soil in building up a tilth and its bearing on natural reproduction (from seed) of teak. Unfortunately also through stress of other work, we have been obliged to sadly neglect the causes and effect of grass, the cycles of the different kinds of grass and the changes wrought in the surface soil by the various grasses. These changes have been brought about as the result of real protection from fire, and the changes which are taking place now will of course continue for several years to come. We have however, been able to appreciate the following results of absolute fire-protection :—The very coarse grasses,* such as *Apluda varia* and *Coix Lachryma*, give place to the medium and finer grasses, such as *Andropogon Schœnanthus.* These again become replaced by lowly grasses, such as *Oplismenus Burmannii.* The indications are that the final stage will be the disappearance of even these lowly grasses and their replacement by humus.

J.—DISTRIBUTION OF TEAK ACCORDING TO THE STOCK MAPS.

18. Besides the associate lists of teak, there are other means of ascertaining the proportion of teak in the forests.

(* I am indebted to the courtesy of Rai Bahadur Mr. K. Ranga Chariar, M.A., Government Botanist, for the identification of these and other grasses —F. F.)

19 It is now the practice every year to draw up a stock map and a description of compartment (annual coupe) which is worked during the year in each range. As the "period" is fixed at thirty years, it will be some time before this is completed. The annual coupe is subdivided into sub-coupes and, as the felling work in each sub-coupe lasts about three weeks, there is plenty of time to draw up a pretty thorough stock map and description while the work is going on. Among other things, some idea is being gained respecting the distribution of the teak-yielding portions of each coupe and sub-coupe. About 5,000 acres have been explored in this manner, of which the returns from some 4,315 acres (7 square miles) are probably accurate enough to be reliable. A *précis* is given below.

Table VI.—Percentage of the Density of Ripe Trees.

Description of forest.	Begur Range.		Chedleth Range	
	Per cent.	Acres.	Per cent.	Acres.
Rich in teak	34	592	27	796
Poor in teak	38	668	39	889
Little or no teak	27	477	19	485
Grass-land, unproductive swamp, rock, fire line, etc.	1	18	15	390
Total ...	...	1755	...	2560

The expression "rich in teak," etc., is admittedly vague, and it is difficult to explain precisely where the one quality ends and the other begins. Fortunately the local forest tribesmen thoroughly understand these distinctions and are able to point out the distinctions on the ground with great facility and accuracy. As experience is gained it will become feasible to lay down a definite standard by which these terms can be systematised into hard and fast distinctions.

The outstanding feature of the table lies in the fact that the teak, even in the teak zone, is not evenly distributed over the area. This is exactly in accordance with the manner in which this species grows and reproduces itself. The reproduction of teak will be dealt with later on more in detail. It is sufficient here to state that where free seedling reproduction is absent the tree reproduces itself from coppice shoots and more chiefly from root-suckers. This is the case at the present time not only in the Wynaad but throughout the teak areas of the Madras Presidency. This method of reproduction of the tree (*i.e.*, by root-suckers) also accounts for its growth in little patches which have so often been noticed and alluded to by writers on the subject, but the significance of which does not appear to have been clearly grasped.

K.—OCCURRENCE OF THE MATURE TREES PER ACRE.

20. So far, the occurrence of teak has been expressed in terms of the percentage. But a fairly approximate idea of the actual numbers of the mature trees in the teak zone can be obtained from the marking registers. During the past five years, these registers have been very carefully kept. Each annual coupe is chain and compass surveyed and plotted to 8" = 1 mile, and their areas are thus known with some degree of accuracy. The total figures for the above period work out as follows :—

Table VII.—Occurrence of Mature Trees per acre.

Range.	Trees marked for felling.	Left as seed-bearers.	Area in acres.	Acres per tree.
Begur	900	613	2,346	1·55
Chedleth ...	1,612	886	3,074	1·23
Total ...	2,512	1,499	5,420	...
Grand Total ...	4,011		5,420	1·35

From this it is seen that the yield of mature trees is approximately one tree per 1⅓ acres. This is a minimum figure: for although each tree is actually marked in Tar and Hammer marked (fellings) or Red Lead (seed-bearer), and although every precaution is taken to thoroughly quarter the ground by subdividing each coupe into sub-coupes, some trees may be missed in this heavy forest and tall dense undergrowth.

But as shown in Table VI above, even in the teak zone 28 per cent. in Begur, and 34 in Chedleth, is practically devoid of teak. Taking the mean as (31 per cent., or say) 30 per cent, and allowing for missed trees, the yield expressed in terms of an average is nearly one mature tree per acre. And as some portions are rich as compared to poor in teak, it is clear that over many acres and the number of mature trees amounts to more than one per acre.

The marking of the trees has been done quite independently in each range, and in the same range by different men in different years. It is interesting to note that although the results are very approximate, showing an apparent homogeneity of crop in both ranges, Chedleth is devoid of teak over 34 per cent., as opposed to 28 per cent. in Begur expressed as an average for the area explored. Consequently the trees in the Chedleth are crowded into a greater density on each of the teak-bearing plots or groups than they are in Begur: and Table IV clearly corroborates this.

[*To be continued.*]

F. FOULKES,
N. Malabar.

LIST OF TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN FOREST CIRCLE OF THE C. P.

(PART III.)

BY H. H. HAINES, I.F.S.

[*Part I. appeared in October* 1912 *and Part II in February* 1913.]

XXV.—ANACARDIACEÆ.

Mangifera indica, *L.*. Am, *H.;* Amba, *Mar.*; Marka marra, *Gond;* Mamidi *Tel.*

A large tree up to 7 feet girth or more occurring in ravines, especially those with a continuous water-supply. It occurs in all districts and is undoubtedly indigenous in localities indicated, especially in Bal., Bi., Rai. and Ch.

It ascends to the top of the Kaman Ghat in the Diri-Mangli forest (Bal.)

Fls. *Feby.—March.* Fr. *May -June.*

Anacardium occidentale, *L.*. Kaju, *Mar.* The Cashew Nut.

With alt. simple entire leaves and terminal panicles of pink flowers is not unfrequent in gardens. The kidney-shaped 'nut' is borne on a large pear shaped receptacle (with calyx base).

Buchanania latifolia, *Roxb.* Char, Achar, *H*, *Mar.;* Chironji (the fruit); Herka Marra, *Gond* (f. Donald); Sarekha, *Gond;* Mora, *Tel.*

A straight, small tree common in all divisions. Bark mostly dark-grey, rough with square bosses L. oblong or ovate-oblong, mostly 6" by 3" Fls. small in terminal branched pyramidal panicles. Frt. black globose.

Fls. *Jany.—Feby.* Fr. *April—May.*

Buchanania angustifolia, *Roxb.* Markaria Char, mota char, *Mar.;* Tolmori, peimota, Muri chetu, *Tel.*

A tree somewhat resembling the last with smaller, narrower, stiffly spreading obtuse leaves 2—3' long, pale beneath and glabrous all over. Panicles smaller of many sub-racemose branches, some of which are axillary. Fruit usually oblique and

4—6" diameter. Open forest, South Chanda, on marl. 'Wood used for making spoons.'—(Donald.)

Fls. *June—July.* Fr *Dec.—Jany.* Some fruits remain until April.

Odina Wodier, *Roxb.* Moyal, Mohi, Mohwai, *Mar.;* Gupri marra, *Gond;* Dumpidi, *Tel.*

Usually a small tree in the C. P., except in the hills. Bark light-coloured smooth in young trees, rough and brown or cinereous in old. On shady slopes attains 6 feet. Blaze bright crimson, streaked or flushed pale pink or white. L odd pinnate with 5 9 entire leaflets, early, deciduous. Fls (when leafless) clustered on numerous terminal spiciform racemes, greenish. Male racemes pendulous and compound, female sub-erect. Ftr. of small red compound drupes.

The C. P. variety has more or less pubescent leaves.

Fls. *March.—April.* Fr. *May —June.*

In all districts. The wood is good, but the tree is not much used as a pole. The branches are cut for elephants.

Semecarpus Anacardium, *L.f.* Bhailawa, *H.;* Biba, Bibe, *Mar.;* Kokha Marra, *Gond.;* Jiri, *Tel.* The Marking Nut.

A usually small crooked or m. s. tree with deep red, rather thick blaze and very large simple oblong or obovate-oblong leaves 8—18" long. Fls. small dull greenish yellow ·25" diameter in panicles. Frt. an oblong or obliquely ovoid drupe black when ripe seated on a fleshy orange cup.

Fls. *June—Sept.* Fr. *Dec. March.*

In all divisions but not very common.

The fruits are sold. They are used as an ingredient in the 'Chob' for elephants' feet.

Spondias mangifera, *Willd* Amra, *H.;* Amera, *Chh.*, Hog-plum.

A moderate sized or large glabrous tree with smooth very thick white soft bark, stout branchlets, and odd pinnate sweet-smelling leaves with 9 -12 leaflets. Blaze pink or light red with

narrow zones of lighter pink Fls. white ·25—·75″ diameter in large terminal panicles on the bare branches, succeeded by large yellow plum-like drupes 1·25′ long.

Fls. *Feby.—March.* Fr. *Jany.*

Nag. Wardha (perhaps only planted); Bil.

Not much used. The fruits are eaten by animals and are occasionally palatable when quite ripe.

XXVI.—MORINGACEÆ.

Moringa pterygosperma, *Gærtn.* Shewaja, *Mar.;* Soajna (N. Ch. W. P.). Drumstick or Horse-radish tree.

A small tree with elegant tri-pinnate leaves and very small leaflets, white irregular flowers in axillary panicles and pendulous ribbed pods 9—18′ long.

Fls. *Jany.—March.* Fr. *April—June.*

Often cultivated. Used as a vegetable.

XXVII.—LEGUMINOSÆ.

A.—PAPILIONACEÆ.

Fls. irregular with two lower petals connate forming the *keel*, a usually broad upper petal (*standard*) and two lateral petals (*wings*) L. simple 3-foliolate or pinnate.

Crotalaria juncea, *L.* San, *H.*

A strict shrub 4—6 feet high with virgate grooved stems and branches and narrow linear or linear oblong leaves 2—4·5″ long which are thinly hairy. Fls. 1″ long yellow racemed. Calyx ·5—·7″ deeply 5-fid densely ferruginous hairy. Pod 1—1·4″ persistently tomentose.

Fl. r.s.—*Jany.* Fr. *Dec.—Feby.*

This is apparently indigenous and is found in most divisions remote from cultivation (*e.g.*, Allapalli forest).

Cultivated for its fibre.

Crotalaria sericea, *Retz.*

A handsome suffruticose herb with leaves 3—6″ long, paniculate racemes of bright yellow flowers 1″ diam. and glabrous pods 1·5″ long. The stipules and bracts are foliaceous.

Fls. *Sep.—Feby.* Fr. *Dec.—May.*

Frequent near nalas, all divisions.

Crotalaria retusa, *L.*

A much branched undershrub 3—4 feet much resembling C. sericea but with small subulate bracts and stipules.

Fl. Fr. *Sept.—Jany.*

Frequent towards Sironcha, S. Ch., Nagpur.

Crotalaria ramosissima, *Roxb.*; Hardul, *Gond.*

A densely branched small shrub 1·5—2 feet high and as broad, densely silky all over with small linear leaves ·5—1" long and yellow fls. tinged with red in numerous few-flowered racemes

Fls. Oct.—Dec.

Especially common on the hills in North Chanda on quartzite rocks. The plant is a pest from the peculiar viscid secretion of the calyx which gives a brown dye.

A number of other less shrubby species of Crotalaria occur, *e.g.*, C. albida, *Heyne* with oblanceolate leaves 2—3" white silky beneath, and flowers in terminal racemes, common; C. linifolia, *L.f.*, somewhat similar but with black globose pods and easily recognised by the corolla drying black; C. hirsuta, *Willd.*, with broadly elliptic soft leaves and leaf opposed racemes; C. mysorensis, *Roth.*, with linear leaves and large hirsute calyx; C. orixensis, *Rottl.*, with tri-foliolate leaves, elliptic or obovate leaflets and long racemes with small ovate bracts and flowers on slender pedicels; C. medicaginea, *Lamk.*, with small trifoliate leaves, dense racemes conspicuous by the sharp back of the keel petals and globose pods.

Indigofera arborea, *Roxb.* (Syn. I. pulchella of F. B. I.), Sakena, *H*; Ramtur, baroli, *Mar.*; Jirula Baji, Pittiporka, *Gond*; Randiporka, *Tel.*

A much branched shrub 4—8 feet high with odd pinnate leaves, 6—8 prs. of leaflets ·75—1" long and racemes of bright pink (rarely white) fls.

Fls. *Nov.—Feb.* Fr. *Feby.—April.*

Common. All divisions, chiefly on metamorphic rock.

The leaflets of a specimen collected at Panchara (Bal.) are 1·7 by ·8".

Indigofera paucifolia, *Delile.*

A small shrub up to 4 feet, with numerous woody branches, pinnate leaves with 3—5 (rarely 1) oblanceolate-oblong leaflets ·5—1 long and small red flowers in racemes. Pod ·5—·75" torulose.

S. Ch., common near Wamanpalli on cotton soil.

Fl. Fr. c.s.

Tephrosia pupurea, *Pers.* Unhali, Inhai, Davali, *Vern.*

A woody undershrub 1·5—3 feet high, with pinnate leaves, often gregarious in open ground and frequently referred to as 'Wild Indigo.' Pods about 1·5" by 15".

Fls. purple or white, *July—Jany.*

Millettia racemosa, *Benth.* Junji nar, *Chh., Gonds ;* Ardhaga, *Kamar.*

A large climbing shrub with odd pinnate nearly glabrous leaves with 11—15 leaflets pale beneath. Fls. ·5" in panicled racemes. Pods black 4—8" long by ·3—·6" broad torulose with 2—4 tapering segments, readily dehiscent.

Fls. *April—May* Fr. *Nov.—March.*

Sihawa Forests (Rai), common ; Sonakhan range (Bil.), common ; Raigarh range (Bal.); Allapalli range, Sironcha range (S. Ch.).

Millettia auriculata, *Baker.* Aghir, *Kamar*, Patani, *Chh ;* Gaj, *H. ;* Gurar, *Bhumia ;* Nasbel (Bal.) ; Nestanda, *Maria ;* Nasar Tige, *Tel.*

A large climbing shrub, or sometimes sub-erect in undergrowth, with odd pinnate leaves and 7—9 pairs strongly nerved leaflets silky beneath. Fls. in numerous axillary racemes 4—9" long. Pod flat sometimes tomentose 4—6" tardily dehiscent.

Fls. *April -June.* Fr. *Jany.—March.*

Root used for killing fish.

All divisions. Rai. ; Bhan. ; Bal. ; S. Ch.

Sesbania grandiflora, *Pers.* Heti, *Mar.*; Agati, *H*

A small tree attaining nearly 2 feet with even-pinnate leaves, large white (or sometimes red) lipped flowers 3—4" long and long slender curved pods.

Fls. c.s. Fr. h.s.

Cultivated. Very quick growing but only lives 3 to 5 years and is useful as a nurse to other trees.

Sesbania ægyptiaca, *Poir.* Jaita, *H.*

A shrub or small tree with even-pinnate leaves and small yellow, purple, often spotted, or red fls. ·5—·75" long in lax racemes. Pod thin torulose.

Also very short-lived. Cultivated. Naturalised in S. Ch. (*Donald*)

Sesbania aculeata, *Poir.* Jaita, *H.*; Sauer, Shevra, *Mar.*; Ran, Savri, *Vern.* (f. Graham); Dhan-dhani, *Chh.*

An annual shrub attaining 7—10 feet during the rainy season and dying in the cold weather. Branches and leaf-rachises muricate. Fls. ·5" pale yellow spotted, in lax racemes. Pod very slender.

Fls. r.s. Fr. c.s. A common weed.

The *Sesbanias* are copiously furnished with large root tubercles and form a good green manure. The first leaf above the cotyledons is simple.

Æschynomene aspera, *L.*

A stout erect soft-wooded shrub with numerous sensitive odd-pinnate small linear leaflets. Fls. ·75" long, hispid. Pod jointed about 2" long usually hispid or muricate on the faces.

Fls. *July*. Fr. r.s.

In tanks, but not common.

The stems are full of pith (Shola) which is used in Bengal for Sun hats, and in the C. P. by the Dimars who tie bundles together and use them for rafts ('Ghora').

Uraria picta, *Desv.*

An undershrub 3—4 feet with 5—7 foliolate leaves with narrow leaflets 3—6″ long usually marked with a yellowish cloud. Fls. small in dense racemes on long bristly pedicels, sepals plumose.

Very common in grassy places and jungles.

Fls. r.s. Fr. c.s.

Uraria hamosa, *Wall.*

An undershrub 3—4 feet with the habit of Desmodium with lower leaves simple, broadly elliptic and upper trifoliolate, with large terminal leaflet broadly elliptic rounded. Racemes rather lax. Common. In similar places to the last.

Fls. r.s. Fr. c.s.

Uraria Lagopus, *DC.*, has mostly 3-foliolate leaves with large oblong leaflets (end one 2—4″ by 1·5—2″) and long dense cylindrical racemes looking brush-like from the crinate pedicels. S. Chanda.

The pod in this genus of which there are other less common species is twisted up so that the joints are brought face to face.

Ougeinia dalbergioides, *Benth.* Tiwas, *Mar.*; Tinsa, *H.*; Sar, *Gondi*; Darji, *Tel.*

Usually a small tree, but attains 4·5 feet girth in favourable localities. Blaze finely closely streaked with blood-red on a white ground. A red juice exudes from the cut. Pinnately 3-foliolate leaves and copious small whitish or pink flowers in fascicled racemes appearing before the new leaves. Pod linear oblong 2—5-jointed.

Fls. *Feby.—April.* Fr. *May-June.*

In all divisions and in some places very abundant, but is much cut out by the villagers.

One of the most valuable woods in the C. P. Red clayey loams appear to suit it best. Some of the straightest trees are, perhaps, those in the Sonawani forest and N. Sihawa, and good trees occur in the zamindari forests between Bhandara and Drug.

Desmodium pulchellum, *Benth.* Chipate, *Mar.* (f. Donald).

A shrub 3—5 feet high with grey-hairy branches. Easily recognised by the inflorescence which far exceeds the leaves and bears double rows of 2 foliolate coriaceous bracts in the axils of which are the fascicles of very small yellow fls.

In the damper forests. Fl. r. s. Fr. *Nov.-Dec.* New leaves in May. Bhan.; Khairagarh; Bal.; Ch.

Desmodium Cephalotes, *Wall.*

A shrub 3—6 feet with much the habit of the last but bracts minute and deciduous. Branches 3-cornered shaggy. Flowers numerous yellow in dense axillary short peduncled umbels often running into leafless racemes.

Fls. *Aug.—Oct.* Fr. *Dec.-Jany.*

Desmodium polycarpum, *DC.*

A shrub usually 2—4 feet usually with numerous erect stems, hairy branches, trifoliate leaves with obovate or elliptic obovate leaflets and purple fls. ·25″ in dense axillary and terminal often panicled racemes. Pod brown hairy 5—7-jointed, joints dehiscent.

Fls. *Sept. Oct.* Fr. *Nov.—Jany.*

In shady places. Bhan.; Rai.; S. Ch.; N. Ch.

(A form collected at Pachmarhi has densely shaggy branches.)

Desmodium latifolium, *DC.*

Erect shrub 3—6 feet high, with densely brown-pubescent branches, sub-coriaceous broad-ovate leaves 3—6″ by 1·5—3·5″ and purple flowers ·17—·2 in numerous often panicled spiciform racemes 2—7″ long

Shady places. Fls. *Aug-Sept.* Fr. *Oct.—Jany.*

Khairagarh; N. Ch.; Bhan.

Several other more herbaceous species occur. The pods of all species of Desmodium are jointed but not twisted up.

Abrus precatorius, *L.* Kunch, *H.*; Gunj, *Mar.*; Jaistband (the root bark).

A pretty twining shrub with even-pinnate leaves 2—3·5″ long, leaflets ·5—·6″ long and small reddish flowers ·5 in crowded racemes. Seeds polished round, scarlet or white, with black eye.

Hedges, etc. Fls. *Sept.-Oct.* Fr. *Nov.-Dec.* Deciduous. N. Ch.; Nag. Probably in all divisions.

The root bark is collected and used for making a drink and as a tonic.

Mucuna pruriens, *DC.* Kawitch, *H.;* Kanchkuri or Khajkuhiri, *Mar.*

An annual twiner with 3-foliolate leaves and stipellate leaflets 3—5″ long and elongate racemes 6—12″ of purple flowers 1·25—1·5 long. Pod 2—3 densely clothed with brown or grey intensely irritating bristles.

Fls. *Sept.—Nov.* Fr. *Jany.-Feby.*

All divisions, in open jungles.

Mucuna imbricata, *DC.*

A large climber with slender sparsely hairy branches 3-foliolate leaves shortly yellow hairy beneath, dull purple flowers in pendulous few flowered lax racemes and pods 5′ by 2″, easily recognised by the two narrow wings on each suture and the obliquely plaited face of the pods.

Fls. r. s. Fr. *Dec.—May.*

Wet ravines. Lormi forests (Bil.).

Erythrina indica, *Lamk.* Pangara, *Vern.*

Occurs on the edges of the fields according to Graham. In leaf it may be distinguished from the next by the absence of the tomentum, and in flower by the much longer racemes and spathaceous calyx. Deciduous.

Erythrina suberosa, *Roxb.* Panjra, *Mar.;* Harwa, *Gond;* Pharid, Parad, *Chh.;* Munimotka, *Tel.;* Gunji (*N. Ch. W. P.*)

A small very prickly tree with pale corky bark, light and dark yellow blaze, 3-foliolate leaves covered with bright brown tomentum beneath and scarlet flowers in capitate racemes only 1·5—3″ long (excluding peduncle). Calyx 2-lipped.

Hills. Fls. *March—May* Fr. r. s. Deciduous up to June.

Frequent. Bhan.; Rai.; N. Ch. N. W. (on sandstone and conglomerate, Kotwalbadi Block).

Spathalobus Roxburghii, *Benth.* Nasbel, *H.* (f. Donald); Gumbori, *Tel.*; Daura Tige, *Maria*.

Large shrub, climbing from right to left, trunk attaining 2—3 feet girth. Leaves 3-foliolate. Leaflets 4—9" by 3—6·5" strongly nerved minutely silky beneath (but see variety). Fls. cream coloured ·31" long 2—3 together in dense racemes. Pods 3—4" brown velvety with single apical seed.

Fls. *Aug.—Jany.* Fr. *Dec.—April.*

Ghot range; Elchil; Dhaba (S. Ch.) N. Ch; Singpur range. N. Sihawa (Rai.), Nirthu (Bil).

Var. denudatus. L. ultimately glabrous.

This occurs in South Chanda.

Butea superba, *Roxb.* Samut, Bodla, *Gond.*; Tel palas, Belia palas, Bachia, *Mar.*; Motum, *Maria*, Motku tige, *Tel.*, Budhua, *Baiga*.

Large climbing shrub, climbing from left to right with trunk attaining 2—3 feet girth. L. 3-foliolate. Lflts 12—18" strongly nerved, subrugose and dull above, nervules raised and pubescent. Branches crowded when leafless with gorgeous orange-scarlet flowers 2—2·5" long.

Fls. *March-April.* Fr. *June-July.*

All divisions, especially on ghats, common.

Butea frondosa, *Roxb.* Palas, *H.*; Chheola, *Bhan.* Tessu (the flowers); Murru, *Gond.*; Motku, *Tel.*; Palsa, Cheula, *Bhunja.*

A well-known small tree with black nodose branchlets on which scarlet flowers 2" long are produced in great profusion. Pods 4—7" with a single apical seed Trees with 1-foliolate leaves occasionally occur.

Fls. *Feby.—April.* Fr. *May-June.*

Very common in all districts, especially on cotton soil in the plains. Palsi lac is chiefly cultivated in Bhan., and to a less extent

in Bal. and Bil. A yellow dye is obtained from the flowers. The wood is used for fuel when dry. The root bark is taken for ropes.

Pueraria tuberosa, *DC* Ban Kunra, *H.*; Bharda, Badra, *Mar.*; Patal, *Gond.*

A large climber somewhat resembling *Spathalobus* in some States and also climbs from left to right. Root large tuberous at some distance below the ground. L. 3-foliolate attaining 12" by 10, usually 6—9", pale beneath with appressed white hairs. Above also with short appressed hairs. Fls. when leafless handsome blue purple or nearly white ·5′ long in fascicled racemes. Pod 2—3" linear somewhat depressed between the seeds.

Fls. *Feby.—April.*

Along nalas and on hillsides

Sonewani and Dhiri Mangli forests (Bal.); Tenduchua forest, (Bil.); N. Sihawa and S. Sihawa (Rai.); N. Ward. (Targaon); Bhan. (umarjhari).

Tuber said to be used as a tonic and for enlarged spleen, also as a cattle medicine and as a food.

Canavalia ensiformis, *DC.* Ban Sim, *Vern*

A very large herbaceous climber with 3-foliolate leaves. Lflts. 2—3" (larger in cultivated forms) broadly elliptic-ovate sparsely appressed hairy beneath and on the midrib above or nearly glabrous. Petiole and rachis together 3—4′, more or less pubescent or hairy. Fls. 1·25′ bright rose-lake with standard 1′ broad, on the swollen nodes of elongate racemes. Pod 4—5′ long thick and fleshy with 5—10 large seeds.

Fls. *Aug.—March.*

Jungles near villages and perhaps an escape. Taroba (N. Ch.); Nag. Pods are eaten.

Two commonly cultivated plants sometimes forming large fields have somewhat the appearance of this plant.

These are :—

Dolichos Lablab, *L.* Popat, *Mar.* The dwarf form, Sim, *Mar.*, the climber, with racemes of purple flowers, campanulate

calyx (the calyx of **Canavalia** is 2-lipped) and short curved pods 1·5—2·5" long *broader upwards*, either erect or climbing, often pubescent. The pods are variable, those of some of the climbing varieties have lost their usual shape and are up to 6" long; these pods are eaten as a vegetable, while usually only the *seeds* of the dwarf varieties are eaten.

Vigna Catjang, *Wall.*

Also either sub-erect or (var. sinensis) twining, glabrous, with stipules ·5—·9" long inserted above the base, few-flowered long-peduncled racemes of white or usually pale yellow tinged with purple, and long linear pods 8—12".

Less common.

Cajanus indicus, *Spreng.* Arhar, *H.*; Tur, *Mar.*

An erect shrub 4—6 feet high with slender grey silky grooved branches, hairy leaflets 1·5—2·5" long and yellow flowers ·75" long in axillary racemes and terminal panicles. Pod 2—3", 3—5-seeded with oblique depression between the seeds.

Commonly cultivated. Often on bunds between the rice-fields. Lac has been tried on it in Raipur.

NOTE.—Many small climbers of the family Phaseoleæ are omitted as of no forest importance though some species are extensively cultivated, *e. g.*, Glycine hispida—Kali Kulthi, *Mar*; Dolichos biflorus—Pandri Kulthi, *Mar.*; Phaseolus aconitifolius—Moth, *Mar.*; are frequent in cultivation.

They are mostly described in the flora of Chota Nagpur. Phaseolus radiatus, *L.* and Dolichos biflorus, *L.*, are wild in the Pachmarhi Hills. Atylosia scarabæoides, *Benth.*, is a very common small twiner, with short hairy lineate pods of which the seeds are sometimes eaten.

Cylista scariosa, *Ait.*

A rather extensive but scarcely woody climber with densely pubescent stems and petioles, softly hairy 3-foliolate leaves prominently venose and microscopically gland-dotted beneath. Fls. in numerous axillary, often branched racemes yellowish and red, remarkable for the papery sub-petaloid calyx which

enlarges to one inch or more in fruit and of which the anterior sepal mimics the Keel petals, and the two posterior sepals mimic the standard of an ordinary papilionaceous plant. Pod glandular, 1-seeded.

Fls., Fr. *Oct.—Dec.*

Nalas and hedges, N. Warda and N. Chanda.

Ryhnchosia suaveolens, *DC.*

An erect shrub 2—4 feet pubescent or hairy upwards with many spreading or drooping branches, 3-foliolate leaves, ovate acuminate leaflets 1—3" long and yellow flowers axillary and terminal on numerous slender lateral shoots. Flowers single or paired on very slender peduncles. Pods oblong ·5—·75" long, turgid, 2-seeded lineate externally but not septate (described as septate in F. B. I.)

Fls. *Dec.—Jany.*

South Chanda, locally abundant (Sirkhonda).

Other twining or trailing species of Ryhnchosia occur.

Flemingia strobilifera, *R.Br.* Chepti, *Mar.*

A shrub, 4—6 feet with simple lanceolate leaves 2—6" by ·7—3" and numerous racemes 2—3·5" long of small white flowers in small cymes in the axils of large folded membranous cordate bracts.

Branches are prominently angled.

Fls. *Jany.—April.*

Very common in Sonawani and Paraswara (Bal.); N. Ch.; S. Ch.; Bhan.; Rai.; Bil. (Sonakhan Forest).

Mr. Donald states that if a man in S. Ch. (a Gond) is stricken by a devil, he obtains relief by inhaling the smoke of the burning leaves of this plant.

Flemingia bracteata, *Wight.*

A shrub 1—3 feet high with simple narrow leaves 3—7" by 1—2·5" and mostly terminal panicled racemes 2—5" long of large folded deeply cordate bracts broader than long. Fls. small pinkish, much as in the last. Branches prominently angled shaggy with long hairs.

Fls. *Jany.—April.*

Flemingia stricta, *Roxb.*

A tall scarcely branched suffruticose species 5—8 feet high from a perennial stock with very large 3-foliolate leaves, narrow leaflets 6—11″ long, 3-quetrous petioles up to 7″ long and dense axillary racemes of purplish flowers conspicuous in bud by the densely imbricated brown linear-lanceolate bracts.

Fls. *Jany.—Feby.* on the new shoots.

South Chanda (Allapalli, Sironcha); Pandratolah Forest (Bal.).

Flemingia lineata, *Roxb.*

A shrub sometimes sub-gregarious, 3—4 feet *high with* 3-foliolate leaves with petioles ·75—1″ long and markedly *plicate* elliptic leaflets 1·5—2·5″ long. Panicles numerous, axillary very glandular pubescent 2—2·5″. Pod ·4″, silky and glandular.

Fl., Fr. *Nov.—Jany.*

Near the Pranhita river (S. Ch.).

Flemingia paniculata, *Wall.*

A shrub 4—6 feet high with rusty branches, rather large ovate cordate simple leaves and small white or reddish flowers, in short axillary racemes or forming terminal panicles 6″ long, without the large folded bracts, but with small simple ones.

Fls. Feby.—March.

S. Ch., common.

Flemingia semialata, *Roxb.*

A shrub 4—6 feet high with densely pubescent angular branches and 3-foliolate leaves with elliptic leaflets 4—5″ long and narrowly winged petiole. Flowers purple ·3″ in densely bracteate axillary spikes.

Fls. *Oct.—Jany.* New leaves in April and May.

Bauhar and Raigarh (Bal.), frequent; Lormi (Bil.).

Flemingia nana, *Roxb.*

A dwarf undershrub somewhat like a dwarf edition of the last The woody rootstock throws up annually large 3-foliolate leave with winged petioles usually preceded by the congested raceme

of small reddish flowers. Like all the Flemingias the leaves are covered with red glands beneath, which are especially abundant all over this plant.

Fls. *March—April.* Fr. *April,—May.*

Leaves die off in the hot season.

Common under shade in all divisions.

Flemingia prostrata, *Roxb.*

Diffuse undershrub with brown tomentose angular branchlets 3-foliolate leaves with lanceolate leaflets. Petiole not winged, inflorescence much as in F. congesta.

Fls. *Aug.—Oct.*

Flemingia involucrata, *Benth.*

A strict shrub 4—5 feet high with pubescent branches, very shortly petioled 3-foliolate leaves with narrowly elliptic leaflets and purple flowers about ·5″ in dense hairy heads surrounded by strongly-nerved oblong acuminate bracts.

Fls. *Oct.—Dec.* Fr. *Janv.—Feby.* Dies down to the root after fruiting.

Grassy laces, Moharli range (N. Ch.); Panchera (Bal.); Sironcha (S. Ch.).

Dalbergia Sissoo, *Roxb.* Sisoo, Shisham, *H.*, *Mar.*

Tree with odd-pinnate leaves, 3—5 rhomboid or roundish cuspidate leaflets 1—3″ long and yellowish fls. in dense panicles 2—3″ long. Fls. with new leaves in March and April. Pod remains on the tree up to the next flowering season.

Not indigenous, but growing remarkably well when sown or planted on ground free from weeds and is largely introduced into Nagpur.

Dalbergia latifolia, *Roxb.* Shishàm, *H.* (Usually distinguished from the last by being called 'Pahari Shisham.') Kala Rukh. *Mar.*; Jitregu, *Tel.*

Tree with grey flaking bark, blaze cream-coloured or white streaked with yellow, rapidly turning brown, odd-pinnate leaves with 5—7 orbicular obtuse or emarginate leaflets 1—4" long and white fls. in lax panicles 2—4" long.

Fls. *Sept.* when the tree is in full leaf. Fr. *Jany-Feb.*

Common in all divisions. Attains 5—6 feet in Chanda, but trees over 4·5 feet, seldom sound, and though it is in great request by the Gun Carriage Factory the trees have been cut or mutilated too much in the past to meet the demand, and artificial reproduction should be resorted to. The tree is succeeding well on Seminary Hill, Nagpur.

Dalbergia paniculata, *Roxb.* Dhobin, *H.*, *Mar.*; Muki Malli, *Tel.*

A usually straight tall tree with white smooth bark, pinnate leaves with 9—15 obtuse, rounded or emarginate leaflets ·5—1·5" long (rarely 1·75"), Fls. ·3" pinkish or bluish white in numerous lateral panicles 2—3" long. Pods panicled 2—3", 1—3 seeded.

Fls. *July*, with the leaves. Fr. *Nov.—Jany.*

The alternating bands of xylem and phloem in the wood easily serve to distinguish the tree when cut. They render the wood useless.

The tall straight habit also distinguishes it from the next species, but on cotton soil it is sometimes low and branched. The leaves are in general much smaller than in D. lanceolaria and dry dark-grey or black, whereas those of D. lanceolaria at first dry green. Common in all divisions. Grows best on loam, but frequent on cotton soil.

Dalbergia lanceolaria, *L.* Pasarginge, *Tel.*; Parekha, *Gond.*

A tree, often large, with white or grey nearly smooth bark, ultimately peeling off in oblong or irregular flakes, and pale yellowish-white blaze very soon darkening. Pinnate leaves with leaflets ·75" to 2·25" by 1·5". Fls. pale pink, bluish or white (the colour distinction of the flower usually given does not always hold good) ·3—·5" in conspicuous panicles which often appear terminal from

the tree being at that time usually leafless. Pods 1·5—3·5″, 1—3-seeded.

Fls. *March-April.* Fr. *Nov.-Jany.*

The pods may be distinguished from those of the last species by the terminal wedge having somewhat rounded sides and a blunt mucro, while in D. paniculata the wedge has very straight sides, running together to a sharp point.

Specimens have only been obtained from N. and S. Chanda where it is not common. The tree will certainly be found in the more eastern divisions.

Dalbergia volubilis, *Roxb.* Gumar tiga, *Tel.;* Adhari, *Gond.*

A sarmentose and scandent shrub with long green branches, 7—13-foliolate leaves and pale purple flowers ·25—·3″ long in large panicles. Pods oblong 2—3·5″ by ·6—·75″ stipitate. Seeds 1—2.

Fls. *Feby.* Fr. *May-June.*

In the moister forests near water-courses. N. Ch., S. Ch., Bhandara, Raipur (Laon range and Sihoa).

Pterocarpus Marsupium, *Roxb.* Bija, Bija-Sal, *H.;* Dhorbeula, Bhula, *Mar.;* Vengur, *Gond;* Pedegi, *Tel.*

A large tree reaching 6 feet. Bark cinerous, rough. Blaze grey-streaked, thin pink finely lined, with exudation of red juice. L. with 5—7 closely parallel-veined oblong or elliptic obtuse leaflets. Yellow fls. ·5″ long with crisped petals, in large panicles. Pod round 1-seeded winged 1—1·7″ diameter.

Fls. *Oct.-Nov.* Fr. *Dec.-Jany.* Nearly evergreen.

In all divisions, especially in Balaghat Hill forests and on N. Ch. sandstones. Less common on trap than on standstone and metamorphic rocks. It is not much used as a pole and should be allowed to attain timber size as it is a most valuable plank wood. The stools are recognisable by the blackening sap.

Pongamia glabra, *Vent.* Karanji, *H., Mar.;* Giranji, *Chh.;* Garanji, *Gond.;* Kanji, Kanuga, *Tel.*

A small or m. s. tree with smooth grey bark and thin yellow blaze. L. with 5—7 opposite oblong or ovate shining leaflets

3—5″ long. Fls. lilac ·5″ fascicled on the rachis of axillary racemes. Pod flattened woody indihiscent oblong 1-seeded 1·5—2″ long.

Fls. *May.-June.* Fr. *Dec.-Jany.*

Appears truly wild, chiefly along nalas in South Sihawa. Is also largely planted. The oil does not appear to be much used in this circle.

Derris scandens, *Benth.* Chakel, *Tel.*; Tupbel, *Mar.*

A very large woody climber with pendant lenticellate branches, shining dark odd-pinnate leaves with 9—11 leaflets 1—3″ long with rather obscure sec. nerves. Fls. pale rose on slender pedicles fascicled in long axillary racemes 4—10″ long. Pods 1·5—3″ by ·4″ lanceolate both ends, very narrowly winged on the upper suture. Seeds 1—2, rarely 3—4.

Fls. *Aug.-Sept.* Fr. c. s.

Plains and valleys. N. and S. Chanda, common.

B.—CÆSALPINIACEÆ.

Fls. irregular or sub-regular. Corolla imbricate with dorsel petal interior in bud. Stamen definite diplostemonous or fewer by reduction, free or united.

Cæsalpinia Bonducella, *Fleming.* Sagargoti, *Mar.*

A scrambling or climbing shrub covered with short sharp prickles, those on the leaf reflexed. L. 2-pinnate, leaflets ·5—1″. Stipules large foliaceous. Racemes with long linear bracts reflexed over the bud. Fls. pale yellow ·5 ·75 diameter, the smaller erect 5th petal marked with orange. Pods at first softly echinate, ultimately 2—3 long and very prickly.

Fls. *Aug.—Oct.* Fr. *Dec.—Feby.*

Hedges. Nag., Wardha.

An oil is got from the seeds.

Cæsalpinia digyna, *Rottl.*

A large scrambling prickly shrub with 5—10 prs. of pinnæ and 7—12 prs. of close oblong leaflets ·25—·5″ long slightly appressed hairy beneath. Fls. showy yellow in simple axillary or

extra-axillary racemes. Pod oblong 1—2" long, thick fleshy 1—4-seeded stipitate crowned by the long style till ripe.

Fls. *July—Oct.* Fr. *Jany.—Feby.*

Bhainsajhar (Bil.).

Cæsalpinia pulcherrima, *Swartz.*

A pretty shrub frequently cultivated in gardens and occasionally running wild in jungles near villages. It has pyramidal elongate racemes of bright yellow and scarlet fls., the crisped petals with a very long claw.

Fls. r.s. and c.s. Fr. c.s.

Cæalpinia sepiaria, *Roxb.* Sagar-goti, *Mar.;* Gataran, *Chh.*

A straggling sub-scandent shrub with recurved prickles on the rusty pubescent branches and leaf rachis, large bi-pinnate leaves with 8—10 prs. opposite pinnæ each with 6—12 prs. of oblong leaflets ·5—1" long. Fls. lemon yellow ·7—·8 "diameter, the small 5th petal often with red lines. Pod dry 2·5—4·5" tipped with the straight hardened style.

Fls. *Dec.—May.* Fr. *March—Jany.*

Hedges. Raj-Nandgaon and Balod range (Rai.); Pantora range (Bil.).

Peltophorum ferrugineum, *Benth.*

A large tree with abruptly bi-pinnate leaves, rusty tomentose shoots and rusty panicles of showy yellow fls. Pod 2—4" winged. Cultivated only.

Flowering and fruiting freely about Nagpur.

Fls. r.s.

Poinciana elata, *L.*

A small or m.s. tree with 2-pinnate leaves, 30—40 leaflets on each pinna and yellow fls. in corymbose racemes. Pod 6—8". Occasionally planted.

Poinciana regia, *Bojer.*

The Gold Mohur tree, with large scarlet flowers, is much planted in stations.

Parkinsonia aculeata, *L.* Deochinda, *Mar.*

A small tree armed with sharp thorns which represent the abbreviated main rachis of a 2-pinnate leaf and bearing 2—6 pinnæ and numerous very small leaflets attaining ·25″ but sometimes altogether absent, the flattened rachis of the pinnae performing the leaf functions; stipulary thorns also often present. Fls yellow in lax axillary racemes.

A native of America but semi-naturalized and growing in abundance on some waste lands near Nagpur and other places.

Does well on cotton soil.

Fls. *Sept.—Oct.*

Cassia Fistula, *L.* Amaltas, *H.*, Danbar, *Kamhar;* Behawa, *Mar;* Rela, *Tel.;* Rera, *Gond.* Pods called Bhawarphali in Bhandara Indian Laburnum.

A small tree with smooth grey or white bark Blaze hard red brown slightly streaked Leaves pari-pinnate with ovate lanceolate acute leaflets 3—7″ long. Racemes drooping of arge light yellow fls. on long pedicels Pods drooping black cylindrical 1—2 feet

Fls. *May—Aug.* Fr. most of the year

In all divisions. The wood is much valued. The bark has been sought for for tanning in Chanda.

Cassia siamea, *Lamk.*

A moderate sized tree with leaves 6—12″ long and 6—14 prs. of leaflets 1·5—2·5″ long and numerous large erect panicles of bright yellow fls

Fls. *Sept.—Dec.*

Commonly cultivated and quick growing The wood is said to be useless.

Cassia auriculata, *L.* Tarwa, *Mar.*

A much branched shrub 3—10 feet with hairy twigs and leaves, and large yellow fls. in terminal corymbs. Easily recognised by the large broad foliaceous stipules (deciduous on old leaves)

Lflts. 8—12 prs. elliptic obtuse mucronate hairy ·6—1". Pods 3—4", 6—10-seeded.

Fls. *Oct.—Jany.* Fr. *Jany.—March.*

South Chanda, chiefly on cotton soil.

The shrub (which is used for tanning in Madras) is not used in the C. P.

Cassia Sophera, *L.*

A shrub 4—7 feet with 6 12 prs. of lanceolate acute leaflets 1—3" long and yellow fls. 1—1 5" diam. in short axillary and terminal panicles.

Fls. *Aug.—Nov.* Fr. *March.*

Occasional on waste land near villages.

Nagpur, etc.; Nunhara (Bn.).

Cassia occidentalis, *L.*

An erect stout fœtid herb or undershrub 2—4 feet high with pinnate leaves 6—12 long, and 3—5 prs. of ovate leaflets 1 5—4" long. Fls. yellow ·5 ·7 diam. in short sometimes panicled racemes. Pod 4—5" flattened slightly curved septate with numerous seeds.

Fls. *Sept.—Nov.* Fr. *Dec.—Jany.*

Frequent on waste grounds during the rains

Cassia tora, *L.* Tatota, *Mar.* Fever-Weed.

An erect herb 1 2·5 feet high with 3 prs. of obovate leaflets, increasing in size from the base of the rachis upwards. Fls. ·5 diam. axillary solitary or paired. Pods sub-terete or 4-angled slender 6—12" long.

Fls. *Sept.—Oct.* Fr. *Nov.-Dec.* Annual.

Not much eaten by cattle and gregarious in waste places and on sites of cattle halts. The leaves are eaten as a sag.

Cassia obtusifolia, *L.*, is said to differ by only having one gland between the lower pair of leaflets while C. tora has a gland between two pairs. The writer has not examined the question in the C. P. (but *vide* Flora of Chota Nagpur, p. 302).

Cassia Absus, *L*, is an erect herb with only two pairs of leaflets and racemes of small yellow or red flowers with only four stamens. It is common in the forests in the rains.

Cassia mimosoides and C. pumila with very numerous small leaflets and ten to fifteen stamens respectively are common in grass and waste lands.

Saraca indica, *L.* Asoka, *H.*

A very beautiful tree, only found in gardens in the C. P. with pari-pinnate leaves and orange scarlet fls. in dense corymbose panicles. It is the calyx and bracteoles in this tree which are showy. The corolla is suppressed.

Fls. *March—April* in its own home, but I have seen it flower ing towards the end of the rains in Nagpur

Tamarindus indica, *L.* Imli, *H.*; *Mar*; Hitta, *Gond*; Chinto, *Tel.*

A very large tree with pari pinnate leaves with 10—20 prs. of small close leaflets ·5" long and small red and yellow fls. in lax racemes, only 3 upper petals and three stamens fully developed. Fls. *April—June*.

Cultivated everywhere and occasionally found semi-wild in rocky jungles.

Bauhinia tomentosa, *L.* Kanchan, *Mar.*

A handsome shrub with young parts tomentose, 7—9-nerved leaves 2—3" long, rather broader than long, lobed less than half way down into two obtuse lobes, laxly pubescent beneath. Fls. yellow or white in axillary or leaf-opposed peduncled pairs with linear bracts or bracteoles Calyx spathaceous ·5". Corolla 2". Pod brown 4—5". Fls. *July—Aug.* Fr. *Jany.—Feby.*

Dhaba Forest (S. Ch.) and in village hedges, N. Ch. Not common.

Bauhinia recemosa, *Lamk.* Dundera Dhondri, *Gond.*; Are, *Tel.*

A small tree with rough grey bark and dark pink blaze, pubescent or tomentose branches, small 2 lobed leaves 1—1·5" by 1·5—2·5" broader than long, tomentose or pubescent beneath (less so when pld.), simple racemes 2—3·5" long of small whitish or yellowish fls. Pod 4—7" rarely 10" long, thick and somewhat torulose.

Fls. *April—June*. Fr. *Nov.—Dec.*, but pods persisting till April.

Evergreen.

Very common in all divisions and frequent on dry hills.

Not much used.

The short very thick podded form is chiefly found on sandstone and conglomerate and is less common than a falcate less turgid variety.

One form (Katora, N. Ch.) with the leaves attaining 4·5 or even 5" puberulous beneath is sometimes difficult to distinguish (by the leaves alone) from B. malabarica and B. variegata, but the principal nerves are only 9 and the sub-acid taste is wanting.

Bauhinia malabarica, *Roxb.* Amti, Sehara, *Mar.*; Koniaphul, *Gond*; Pula are, *Tel.*

A small tree attaining 4 feet, girth with bushy crown, bark light brown grey nearly smooth or with narrow linear-oblong flakes when old. Blaze hard pinkish red and pink turning red, or bright deep crimson in old trees. Branches pubescent. Leaves dark green 1—4 diam., broader than long, usually grey and glabrescent beneath (occasionally minutely pubescent when old) with 9—11 primary nerves. Fls. sub-regular whitish on slender pedicels in corymbose or *branched* racemes. Pod 7—12" by about ·7" flattened curved beaked; when dry very closely conspicuously veined.

Fls. *Sept.—Nov.* Fr. *Jany.—March.* Evergreen.

Along valleys only. Bhandara (Umarjhari); South Chanda; Dabori (N. Ch.); Singpur and Sihawa ranges (Rai.).

The leaves have a pleasantly acid taste and somewhat resemble both those of *racemosa* and *variegata*.

Bauhinia variegata, *L.* Kachnar, *H.*; Thaur, *Mar.*; Dhondri, *Gond.*

A small or mod. sized tree with grey longitudinally cracked bark, pale pink or flesh coloured blaze darkening on exposure, leaves 2·5 by 3 to 6 by 6·5 usually about 5·5" long pubescent especially on the nerves and grey glaucous beneath Primary nerves 13—15 rarely only 11 Lobes of leaf rounded. Calyx spathaceous, tube 1—1·24". Petals obovate 2 2·5" pure white or purple with one petal variegated with yellow. Buds *terete.* Pod 9—12" by ·7—1 .

Fls. *Feb.-April*, the upper part of the tree then being leafless. Fr. *March May.*

Chiefly on hilly ground. Sukri, Samnapur, Supkhar (Balaghat), S. Chanda (*F. Donald*).

Bauhinia purpurea, *L.* Koilar, Sehara (*F. Donald*); Pedda are, *Tel.*

A small or mod. sized tree (not unfrequently flowering as a bush) with ashy or dark brown bark, blaze underneath the outer bark) with or without a pink band, then pale yellow rapidly darkening, then nearly white, centre (on wood) yellowish Leaves deeply lobed from one-third the way down to sometimes near the base which is 9—11-nerved and the lobes have usually angular tips. Purple fls. in panicled racemes. Buds acutely *5-angled.* Pod 6—12 .

Fls. *Sept.—Dec.* Fr. *Jany.—March.*

Frequent along valleys, especially along the streams in all divisions.

The leaves are eaten.

Bauhinia retusa, *Ham.* Koilar, *Mar.* (but these names are much mixed up), Sehra; *Chh.* Kangali, *Gond.*; Dondir, *Maria*; Tawarrukh, *Bhumia*; Nirpa, *Tel.*

Blaze dark grey brown outside, then very pale pink. A mod sized or small tree with the leaves different from the other Bauhinias described in the leaves being quite entire or only slightly

emarginate. L. 4—7″ broad with 7—11-nerved base. Fls. one inch diameter white in ample terminal panicles. Pod straight oblong or broader upwards 5—7″ deep red until ripe.

Fls. *Sept.—Dec.* Fr. *Feby.—March.* Evergreen

Chiefly in valleys. Common in Dhamtari range, North Sihawa and South Sihawa (Rai); Lormi and Pantori ranges (Bil.); Markhanda and Ghot (S. Ch); Bhandara, on quartzite rocks near Deori (82nd mile); Baihar and Raigarh ranges (Bal.).

Bauhinia Vahlii, *W. and A.* Mahul, *Mar., H.;* Pawur tige, *Gond.;* Parad, *Tel.*

An immense climber, stems attaining 2—4 feet girth, with deeply 2-lobed leaves from 3″ to 18″ diameter and corymbs of large white or cream coloured fls. Pod woody, 6—12″ long.

In all divisions, but chiefly on the hills and in stony places. Very common in Dhiri-Mangli forest (Bal).

Fls. *April—June.* Fr. *Dec.—March.* Sub-deciduous, renews leaves in May. Rope is made from the bark, and the seeds are eaten.

Hardwickia binata, *Roxb.* Anjan, *H.*

A large and beautiful tree with bluish and green foliage and drooping branchlets with small leaves resembling those of a Bauhinia but split into two distinct basal-nerved leaflets. Flowers very small, whitish, without corolla, in axillary and terminal panicles. Pod samaroid, 1-seeded.

Fls. *July.—Aug.* Fr. *Feby.—March.* Evergreen. New shoots in April.

Very local in wild state, south of Allapalli, and in Sironcha (S. Ch).

Is extensively planted in Nagpur, where it grows well on the trap hills. It is best sown where it is to remain, and remains very small for the first two or three years. In Sironcha it attains 7—8 feet girth.

C.—MIMOSACEÆ.

All the plants in this family have, 2-pinnate leaves, except Inga, and small crowded fls. in heads or spikes. Stamens usually indefinite.

Xylia dolabriformis, *Benth.* Suria, *H. M.*; Suaba, *Gond.*; Bhoja, *Tel.*

A large or (in C. P.) usually small tree, with brown tomentose thick branchlets, 2-pinnate leaves with only one pair of pinnæ, white flowers in globose heads on long peduncles from the axils of the fallen leaves. Petiole together with main rachis of leaf 2—5". Sec. rachis 4—13". Petioles swollen. Lflts. normally 5—6 prs. rarely 2—3 or 7 prs. basal usually ovate, upper oblong obtuse or with short blunt cusp or shortly acuminate, 2—8", base obtuse or cuneate, sec. n. fine oblique, 7—12 prs. Glands 4—5 on rachis between upper leaflets. Peduncles 1—2". Heads ·5"—·75" diam. (without stamens) usually paired from the axils of the undeveloped leaves and so appearing clustered at the ends of the shoots, peduncles 1—2". Fls. often 1-sexual. Corolla 1·5 times as long as the calyx. St. 9—10 apiculate; at the end of the apiculus there is a deciduous gland. Pistillode fulvous hairy. Pods 5—6" woody, somewhat curved, broadest above the middle.

Fls. *April—May.* Fr. ripens March.

Usually in valleys, Bhandara (on the top of quartzite escarpments at Chicholi) frequent, but rarely 3 feet girth; N. Ch.; S. Ch., frequent (a tree of 6′ 10″ measured in Allapalli forest), Bal. (Dhari-Mangli forest); Rai. (Harrathema forest). The wood is scarcely used.

Entada scandens, *Benth.*

An immense woody climber with 2-pinnate leaves ending in a 2-fid. tendril, solitary or fascicled axillary or extra-axillary spikes 4—9" long of very numerous small green fls. Pods very large and woody 1—2 feet long with large discoid chestnut-coloured seeds 1·5—2" diameter.

Fls. *April.* Fr. ripens *March—April* of following year. Deciduous, March.

Ravines in the Lormi Hills (Bil.).

Dichostachys cinerea, *W. and A.* Sagun-kanti, *Mar*; Velatur (f. Graham).

Large branched woody shrub or small tree looking like an Acacia, the twigs mostly ending in a thorn, remarkable for its curious parti-coloured tassel-like heads of fls., the lower part of the spike which is 1—2″ long, consisting of imperfect flowers with staminodes ·5″ long, being bright rose coloured, the upper yellow with minute perfect flowers. Bark grey. *Branches* armed with short lateral and terminal *straight* thorns. L. 1—3″ long only, leaflets minute, ·05—·1″ long. Pods curled and twisted.

Fls. *Aug.—Jany.* Fr. *Oct.—Dec.*

Frequent, especially in Nag., Wara. and N. Ch. on black cotton soils.

Parkia biglandulosa, *W. and A.* Drumstick tree.

A tree, very commonly planted, with large feathery 2-pinnate leaves 12—20″ long with 2-glands on the petiole. Heads of narrow tubular fls. 2″ diameter on long rusty stout peduncles, globose with lower third constricted. Pod large.

Fls. *Feby.*

Leucaena glauca, *Benth.*

A small tree, or flowering as a large shrub, leaves with 4—8 pairs of pinnæ and linear glaucous leaflets ·3—·5″ long, small white flowers in fascicled or panicled heads 1″ diameter. Pods very numerous, brown.

Fls. *May—Aug.*

Very commonly planted, and often self-sown in moist situations.

Mimosa rubicaulis, *Lamk.* Chilati, *Mar.*

A weak very prickly shrub 6—12 feet with many branches from the root. L. with 6—12 prs (8—20 according to F. B. I.) of *distant* pinnæ 1—2·5″ long and 8—20 prs. of small leaflets. Rachis beset with curved prickles. Flowers pink or whitish in pretty heads ·5″ diam. becoming panicled at the ends of the branches. Pod rather falcate, thin, 3—4″ breaking up into square 1-seeded joints.

Fls. *Aug.—Oct.* Fr. *Nov.—Jany.*

Branches die down or shed their leaves in the hot season.

Easily confused with the next and is believed not to occur in the Western Districts of N.-Ward. and Chanda.

Mimosa hamata, *Willd.* Chilati, *Mar.*

Strongly resembling the last. It is distinguished chiefly by its fewer pinnæ (only 6—8 prs.) and by the pod being armed with curved prickles. The pinnæ are also shorter than in rubicaulis. but this character is not constant.

Fls. and Fr. the same time as the last.

Appears more abundant in the C. P. than M. rubicaulis and occurs in all divisions, being especially abundant in the west of the area.

M. rubicaulis is rather a plant of moister regions (though a very tomentose form occurs in the Punjab) and M. hamata of the Deccan and Bombay.

The Acacias are all prickly shrubs or trees distinguished from Mimosa in the pod not breaking up into joints and usually 5-merous flowers.

A.—FLOWERS IN GLOBOSE HEADS.

Acacia Farnesiana, *Willd.* Dei babul, *H.*; Gandhi babul, *Mar.*

A shrub or small tree. L. with 4—8 prs. pinnæ and 10—20 prs. of minute leaflets Heads of deep yellow flowers very fragrant on axillary peduncles ·5—1″ long. Pod brown thick and swollen.

Fls. *Aug.—March.* Fr. *Jany.—July.* Evergreen

Often planted and semi-wild.

Acacia arabica, *Willd.* Babul, *H.*

A tree with deeply cracked black bark (often flowering as a shrub) armed with long, straight white thorns on the branches. Blaze very hard, similar to A. Catechu but lighter pink, white

on the wood. L. 3—6 prs. of pinnæ and pinnæ with 10—20 prs. leaflets. Pod whitish deeply constricted between the seeds.

Fls. *Aug.—Dec.* Fr. *Jany.—Mar.* Evergreen.

In all divisions but chiefly on trap with cotton soil in the western divisions.

The tree does not coppice, and long grass is most inimical to its reproduction. The three varieties distinguished in Berar do not appear to be recognized in the Southern Circle. Pods as well as leaves are largely used for fodder. There is no general trade in the bark from the forests of the circle, as most of the babul tracts are now cultivated.

The 'Indian Gum Arabic' according to the Linnæan Herbarium has white thin moniliform pods. The 'true Gum Arabic' (nilotica) has not the white tomentum and the very moniliform pods have *oblique* joints. Are the very compressed white pods usually seen in the herbarium unfertile?

Acacia eburnea, *Willd.* Dev babul, *H.*

"A small tree resembling Babul but pinnæ 7—8 prs. and leaflets only 8—9, rarely 13 prs. Pods dark reddish falcate up to 3" by $\frac{3}{8}$" thin, flat, venulose, only faintly constricted between the seeds."—*Donald.*

It may usually be distinguished from the Babul by the large white very conical geminate thorns, by having 2—5 prs. of pinnæ only, each with 6—8 prs. of broad leaflets. The pod also is only repand not deeply constricted.

"Dighori forest (S. Ch.) on black soil"—*Donald.*

Acacia leucophlœa, *Willd.* Hiwa, *Mar.*; Tunua, *Tel.*

Usually a small tree but attaining 6 feet girth, with white trunk when young, when old with deeply cracked bark below and white smooth branches. Blaze light red slightly white streaked.

L. small, the 6—12 prs. of pinnæ only 1—1·5" long. Heads small, ·25" in copious terminal panicles, pale Pods panicled 4—8 by ·2—·3" tomentose.

Fls. *Aug.—Oct.* Fr. *Dec.*

Very common, especially on the trap and on the cotton soil. Not recorded from the metamorphic rocks of Bil. and Rai. (though found there on black cotton). Not of much value. Very large trees are found grown up with new growth in S. Chanda, probably the remnants of a more open forest.

B.—FLOWERS IN AXILLARY SPIKES.

Acacia Catechu, *Willd.* Khair, *H.*; Sandra, *Tel.*

A small tree, usually crooked, with black bark peeling off in vertical strips, branches mostly armed with paired (stipular) hooked prickles. Blaze very hard, vandyke brown and then deep pink. Branchlets pubescent. Pinnæ 7–22 prs. with rachis from ·5″ (on very small leaves) to 1·5″ long, pubescent or hairy. Leaflets 6—35 prs. (mostly 12—20 prs.), ·1—·2″ long, sessile, ciliate. Fls. small white or pale yellow, crowded on pubescent spikes 2—2·5″ long. Fls. ·1″ long (without stamens), the corolla about twice as long as the calyx, both pubescent. Pods 2—5″ by ·6—·8″ often constricted, 4–7 rarely only 2 seeded, obtuse mucronate or beaked, base constricted into a pedicel and pubescent, above glabrescent.

Fls. *June—July*. Fr. *Nov.—Dec.*

All divisions, from the plateau of Balaghat (Jhiria), Mahasamund (Raipur), Kolsa (N. Chanda) to Dhaba forest (S. Chanda).

A valuable wood, largely used in native buildings. I have described the tree fully on account of the question of distribution of the Indian 'Khairs,' *vide* Prain (Some Additional Leguminosæ, p. 509). The species obviously is Catechu *proper* notwithstanding that it bears the Telegu name 'Sandra' and that it has hitherto not been reported from the Deccan. I have not met A. Sundra, D. C., in our area.

Acacia ferruginea, *DC.* Kat Khair, Pandra Khair, *Mar.*; Safed Khair, *H.*

Fairly straight tree 2—4 ft. girth with grey bark cracking into oblong pieces. Blaze light crimson (deep crimson in the old trees) with thin white concentric lines. Prickles paired small ·1—·15″,

slightly curved. Branchlets pubescent. L. rachis 1·5—2·5" with 3—5 prs. stalked pinnæ each with 10—18 prs. lflts. Lflts. ·25—·35" glaucous almost white when dry. Pod about 4" up to 6·5" long by ·8", 4—6 seeded, upper suture margined. As the tree is nearly bare of leaves at the time of flowering the spikes appear panicled.

Fls. *March—April* (*Jany.—Feby.* according to Witt). Fr. *Nov.—Dec.*

On trap and cotton soil in extreme south of Umrer (Nag., Ward.); Warora range (N.Ch.); Dhaba range (S.Ch.).

Wood said to be useful but softer than that of A. Catechu and lighter coloured.

Acacia lenticularis, *Ham.* Khair, *Bhumia*; Kolsa Kanta, *H.*; Kirngi, *Gond.*

A pretty tree 20—40 ft. superficially resembling an Albizzia rather than an Acacia with rough brown grey bark and bright green foliage with large leaflets. Armed with slightly curved stipular prickles ·12—·19" long. Pinnæ 2—4 rarely 5 prs. 3—5" long. Lflts. 6—12 prs. glabrous ·75—1·5" by ·6". Spikes white 4—5". Pod 5—9".

Fls. *May—June.* Fr. *Dec.*

Both on trap and mica schist rocks in hills.

Jhiria, Kursipar, Bhaisanghat (Bal); Bankal, Lormi forests, (Bil).

Wood said to be very hard and strong.

C.—CLIMBERS (EXCEPT IN THE FIRST SPECIES) WITH WHITE FLS. IN GLOBOSE HEADS USUALLY IN PANICLES.

Acacia Donaldi (Sp. Nov. near pennata). Chil, Chili, *Gond*

A small tree up to 2·5 ft. girth with light coloured bark, very rarely scandent. Blaze slightly pink, streaked. Prickles more or less 5-seriate on the branches but less obviously so than in next species. Twigs finely pubescent. Leaf rachis 3—10" (usually 4—5·5") with very short swollen petiole and a flattish or rudimentary gland immediately above it and between the 3—4 upper

pinnæ, with very small weak prickles on the lower rounded surface. Pinnæ extending to within half an inch of base of rachis 10—27 (usually 16—20) pairs ·3—5" apart, median pinnæ 1·5—2" long. Lflts. linear 25—40 rarely 50 pairs, on median pinnæ ·25—·5" by ·03—·05".

Pods green to pale yellow and whitish-brown, ultimately grey, rather turgid when unripe up to ·25 thick, of two forms (*a*) 3—5 by ·8—1 with about 6 oblong brown seeds, (*b*) 5—6" by ·8" with rounder darker seeds, base attenuate but pedicel, if any, not exceeding 2".

Fls. r. s. Fr. ripens *Nov.-Dec.*

On sandstone and quartzite plateaux extending from the Balod range eastwards and northwards to the Laun range (Rai.), and Sonakhan range (Bil.).

Acacia pennata, *Willd* Chilati, *H.*; Jari, *Mar.*

A large woody climber with light coloured smooth bark (very old stems are rough below) which on the branches and even in fairly old stems show longitudinal brown lines of minute prickles. Blaze bright crimson. Branches more or less 5-angled with lines of small prickles on the angles. Leaf with basal portion of rachis bare for one-third of its length or for 1—2" and bearing a conspicuous gland, with raised margins about half way up the bare portion. Pinnæ about 10—20 prs. 1—2" long and ·25—·3" apart. Lflts. linear 18—40 prs. ·1—·25" long. Fls. white. Pods purple 4—6" with cuneate base and a pedicel usually over ·2" and often ·6" long. Fls. *May—Aug.* Fr. *March—April* (quite thin and unripe in Dec.).

In all districts chiefly along ravines and nalas.

Acacia caesia, *W. and A.* Chilhati, *Mar*

A large scrambling climber, stems sometimes channelled, old trunk attaining 2·5 ft. girth with rough bark and brown blaze, on younger stems bark bright grey nearly smooth and blaze slightly pink. Branches usually with five lines of prickles, young tomentose. Leaf rachis 6—10", armed, with 12—20 prs pinnæ with

rachides usually 3—4" (sometimes only 2" or up to 5") ·4—·5" apart pubescent. Glands basal and between 5—10 uppermost pinnæ. Lflts. oblong 30—45 prs. rigidly spreading (except in sleep) ·25—·31 by ·1- ·15" always somewhat pubescent beneath. Pods flat dry with strong sutures 3—5·5" by ·6—1" usually cuneate at both ends, light brown, with a rusty tomentum when young.

Fls. *May—Sept.* Fr. *Jany.—March.* Evergreen. New leaves in March.

Exceedingly common in all districts but more especially on rocky ground with sandstone or quartzite rocks

N.B.—This is not the Mimosa caesia of Linnaeus.

Acacia concinna, *DC.*

A scrambling climber with 4—8 prs. of pinnæ and 15—25 prs. of leaflets ·3—·6" by ·19". Pinnæ ·7—1" apart Pod thick fleshy 2—4" long.

Fls *March—June.* Fr. *Jany.—March.*

It is doubtful whether this occurs in the Southern Circle but as it occurs in the Northern Circle and in the Deccan it will probably be found.

Albizzia is distinguished from Acacia by the monodelphous stamens, by being usually without prickles and by the generally larger leaflets.

Albizzia Lebbek, *Benth.* Chichola, Sankesar, *Mar.;* Siris, *H.* East Indian walnut.

A m. s. or large tree with cinereous rather rough bark. Blaze deep crimson or red. Pinnæ 2—4 prs. Lflts. 6—8 prs. rarely 13 prs., 1—1·5" long, rarely twice as long as broad, oblong rounded glabrescent, drying green. Peduncles 2—4" long axillary or shortly panicled (from late development of the leaves). Fls. with distinct pedicels which attain ·2" long. Pods straw coloured 1—2" broad. Seeds large exceeding ·5" diam.

Fls. *April—June.* The pods ripen January and remain on the tree during the hot weather when the tree is quite bare of leaves.

I have come to the conclusion that this is nowhere wild in our area. It is very commonly planted but the tree often called A. Lebbek is var. lebbekifolia of the next species.

A tomentose variety (var. pubescens) occurs, in which the pedicels are shorter, the leaflets are more or less permanently hairy and more narrowly oblong and, as there may be as many as 13 prs., it is practically indistinguishable in leaf only from the next species. I have suspected hybridization.

Albizzia odoratissima, *Benth.* Chichwa, *Mar.* (but the name chichwa is often applied to any Albizzia). Terju hitta, Terju chinta, *Gond* ; Shin dugu, *Tel.*

A small or large tree with sandy coloured grey or cinereous bark. Blaze thick, deep crimson. Pinnæ 2—5 prs. Lflts. 6—24 prs. oblong or narrowly oblong or somewhat falcate ·6—1·2″ by ·25—·5 (but see var.), usually twice to three times as long as broad and usually drying grey. Peduncles ·75 –1·25″ usually panicled. Fls. sessile. Pods purplish green to brown red-brown when quite ripe up to 1·25″ broad, minutely hairy. Seeds under ·4″ diam.

Fls. *May—July.* Fr. *Nov.—Feby.*

Common in all the forests. The typical tree is graceful and often with drooping foliage which is generally pubescent.

Var. lebbekifolia, *Haines* Bark grey. Blaze deep crimson. Lflts. 6—11 prs. 1—1·9″ by ·4—·8″, old with minute scattered adpressed hairs both sides. Peduncles under 1·25″. Pods up to 1·3″ broad and often stipitate, otherwise as in type. The shortness of the peduncles, the sessile fls. and colour of the pods easily distinguish it from A. Lebbek but with foliage only it is practically indistinguishable.

Quartzite plateaux, Warora range, and Taroba, N. Ch.; Sandstone, Bejurpalli and Sironcha, S. Ch. Substantially similar forms occur along the Mul road.

Albizzia Thomsoni, *Brandis.* Sailari, *Gond.*; Seljhari, *Mar.*; Kondalachetu, *Tel.*

A large tree attaining 7 feet girth. Bark roughish dark grey like that of A. Lebbek. Blaze crimson (not thick) yellowish

within, on young trees yellow then pink. Branchlets and young parts tawny tomentose. Pinnæ 5—10 prs. 2—4" long. Lflts. about 20 prs., obtuse, slightly falcate, larger ·5 by ·25" rarely ·6" with sparse adpressed pubescence beneath or glabrous except on the midrib but the minute petiolule brown tomentose. Principal nerve nearer upper margin, other smaller basal nerves 2. Heads corymbose on peduncles 1·5 - 2" long. Fls. pale yellow with pink anthers. Pods many red 6—8" by ·6 -1" (Brandis says 1·5"), sutures thickened pubescent. Seeds 7—8.

Fls. *Feby—March*. Fr. *Dec.* Deciduous *Jany.—Feby*

S. Ch. and N. Ch. extending as far north as the sandstones. Often only a small tree on the dryer plateaux.

Albizzia procera, *Benth.* Safed Siris, *H.*, Kinhi, Kinhi-phata, *Mar.*; Gurar, *Gond.*; Passarjini, *Tel.*

A large tree with greenish-white bark (except below on very old trunks) and red blaze easily distinguished from the other species by the large leaflets 1—2·3" by ·5—1·2", which are much broader on the upper (acroscopic) side of the principal nerve. Heads 1—4-nate, copiously panicled. Pod green 4—8" by ·5—1".

Fls. *Aug.-Sept.* Fr. *Dec.-May.* Deciduous *May—June.*

Along nalas in all districts but not usually common, occasional also in the damper forests and near tanks and rice-fields.

Albizzia amara, *Boivin.* Seljhari, *Mar.* (?)

A small tree with innovations softly yellow tomentose, main rachis 2—4" and 6—15 prs. pinnæ 1—3" long with numerous close small linear leaflets ·25" long. Flowers yellow fragrant in heads ·3—·5" diam. peduncles about 1" several in axils of new leaves or terminal panicles (owing to late appearance of leaves). Pod 4—6" by ·7—1", pubescent.

Fls. *Mar.—May.*

Only seen on the Laun sandstone plateaux in Raipur.
Wood said to be strong and useful.

Pithecolobium dulce, *Benth.* Simchita, *Tel.*

A pretty tree with spinose stipules. L. with one pair of pinnæ each pinnæ with one pair only of small oblique leaflets 1—2″ long. Pod twisted.

Fls. *Jany.—Feb.* Fr. *April—June.*

A native of Mexico. Often cultivated and if cut back forms a good hedge.

Enterolobium Saman, *Prain.* The Rain Tree.

A large tree with spreading crown and dark grey bark. *Pinnæ 3—7* pairs, larger with 8—10 prs. of leaflets 1—2″ long rhomboid, with principal nerve diagonal. Heads rose-coloured. axillary. Pod 5—8″ fleshy.

Fls. *May June.* Fr. *Mar.—April.*

Often planted. Lac occurs on it in Chanda.

RASAUNT.

Rasaunt is a brown extract prepared from the root and lower stem wood of *Berberis aristata*, *Berberis Lycium* and probably *Berberis asiatica* or *coriaria*. The Berberis is locally called *Kemlu*.

2. *Rasaunt* or *Rusot* is extracted in other places than in the Kashmir State, and its properties appear to have been known to the ancients. Its extraction appears to extend to as far east as Garhwal.

3. In the Jammu and Kashmir State the industry is centered in the outer hill forests between the Chenab and Ravi rivers, or in the Forest Divisions of Riasi, Ramnagar and Jasrota where the extraction lease is sold by yearly auctions, by Divisions. In the current year it is estimated that over 1,600 maunds will be removed, the revenue from which being over Rs. 16,000. The extraction has increased considerably within recent years, and the time has come to organise it, so that the plants and the fuel are not exhausted. With this end in view, this note is written.

4. In boiling out the product large quantities of green fuel are burnt. The common species used are banj (*Quercus incana*), keint (*Pyrus Pashia*), kakoa (*Flacourtia Ramontchi*), kembla

(*Mallotus philippinensis*) and other broad leaves. Dry fuel is objected to as being more difficult to control in the kind of furnace used.

Skilled labour is available, apparently in reasonably large quantities, from amongst the Megs and Doms and other low castes of this locality. Their services are given when their agricultural work slackens, *viz.*, July to September and January to March.

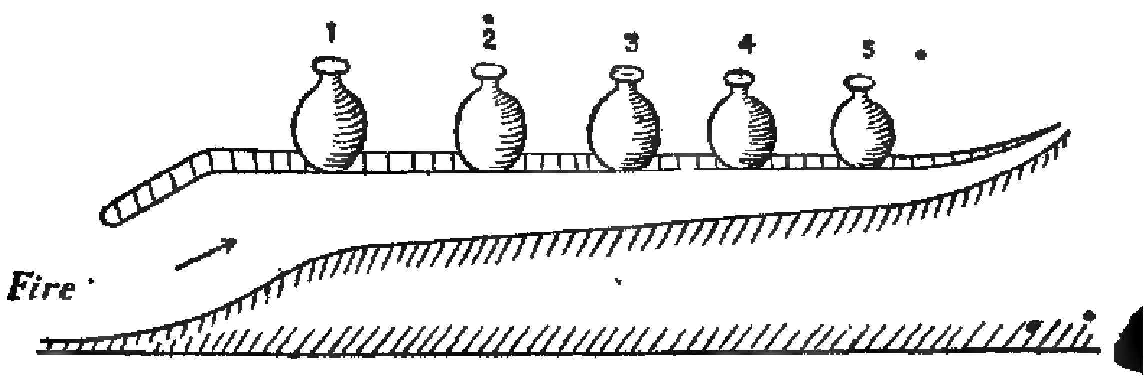
METHOD OF EXTRACTION.

5. The roots of the berberis are dug up and after cutting off, say, the upper ¾ of the stem branches are well washed to remove all earth and foreign matter. They are then cut up into small pieces, the smaller the better. In the Basantgarh Range the sizes of the chips are about 1½" or 2" × ¼" or ½", but in the Basohli Tahsil (which prides itself on producing a better quality Rasaunt) the pieces are much smaller.

The chips are then put into earthen pots, in the proportion of 3 seers of chips to 5 seers of water, the pots being roughly 1' high by 7" diameter.

These pots are then placed in two parallel rows on the top of a long furnace, the pots being sealed with clay into the small holes left on the top of the furnace for their reception, thus closing all cracks to the draught and distributing the heat from the fire evenly throughout the flume of the furnace.

The following sketch gives an idea of the furnace commonly used :—



Section showing position of flume and pots The pots are a few inches apart, and there are two parallel rows, from five to seven pots being in each row.

In Basohli pot 1 of each row at first contains water, put there to prevent the pots from cracking, and the chips and water are put into pots 2, 3, 4, etc. To lessen evaporation other pots are inverted over pots 2, 3, 4, etc., and sealed on, the bottoms being perforated to allow steam to escape.

In Basantgarh an iron pan (Karahi) takes the place of the two pots and inverted pots are not, as a rule, used; otherwise the arrangement of the pots is the same.

6. The boiling goes on for about six hours. As water evaporates fresh water is poured in so as to keep the chips always well covered. At the end of this period the contents of pot 2 are poured into the practically empty pot 1, the contents of pot 3 into pot 2 and so on. This is not done quickly but leisurely and water added to rinse the chips. Where the iron pan is used, the extract is poured into that instead of into pot 1.

In this way the liquid contents of all the pots eventually finds its way to pot 1 on each row, or into the iron pan where it is still further evaporated until sufficiently concentrated. It is not known how long this takes, but apparently there is no hurry about it, and it may stand for some days or for a few hours. When ready it is of the consistency of a thick treacle, and is poured out into small receptacles made of the leaves of *belangor* (Bauhinia Vahlii) where it cools and thickens; eventually being packed into baskets for transport to Amritsar.

COST.

7. The local cost of extraction including all details is about Rs. 5 a 40-seer maund. For transport to Amritsar the contractor pays Rs. 2 a maund.

VALUE.

8. The principal mart for this, and most minor products of these parts, is Amritsar The value of Rasaunt at Amritsar up to this year ranged between Rs. 22 and Rs. 30 a maund. This year in consequence, it is said, of extra supplies from Chamba, the value has dropped to Rs. 18 to Rs. 25 a maund.

USES.

9. The larger part of the 'rasaunt' extract appears to be exported from Amritsar to Multan, whence it probably extends to Sindh and other desert tracts. Its use is largely in mixing with drinking water. What its effect on the water is, is not known to the writer at present, but its presence probably neutralises a salt, as it is said to make the water "cooler."

Another important use, and one known in many countries, is in the treatment of ophthalmia, the medicinal principle being *berberine*.

Besides it is said to be used for piles, and as a tonic and laxative.

10. The information for the above note has been obtained from Range Officers Pt. Raj Narain and Pt. Kashmiri Mal when the writer was on tour in the Ramnagar and Jasrota Divisions. Improvements in the furnace and the method of boiling are no doubt possible with a view to lessen the consumption of fuel and to quicken the process.

W. H. LOVEGROVE,
Conservator of Forests,
Jammu and Kashmir State.

CAMP:
19*th February* 1914.

EXTRACTS.

THE HIGHEST TREE IN THE WORLD.

To the Editor of the *Scientific American*,—

In your issue of November 22nd, 1913, page 398, reference is made to the tall trees of Australia, implying that they exceeded the height of those found elsewhere. Having resided in Australia for ten years, and being fairly well acquainted with the trees there as also with the literature on the subject, it occurred to me that an explanation would not be out of place; hence, I am sending as an inclosure some extracts from Mr. Maiden's work, which is everywhere considered authoritative.

THE GIANT TREES OF AUSTRALIA.

The following is extracted from *The Forest Flora of New South Wales*, by J. H. Maiden, Government Botanist, page 162, in reply to the note which appeared in *Scientific American* for November 22nd, 1913, page 398, which reads as follows : –

" It is claimed that some of the eucalyptus of Australia are taller than the California redwoods, which are commonly considered the highest trees in the world. "

Visitors to the Melbourne International Exhibition of 1888 will remember the photographs of a large-butted gum-tree by Mr. N. J. Caire, photographer, who stated that he had come across this monster in Gippsland, and that its height was 464 feet. Here was something very definite to go upon. The trustees of the Public Library, Melbourne, voted £100, the trustees of the Exhibition Building another £100, the Minister for Lands promised a sum not exceeding £800, to have this leviathan measured and photographed. After some hesitancy on the part of the photographer, the identical tree photographed was found. The Inspector of Forests and a Government surveyor measured it accurately, and found it to be 219 feet 9 inches. Here was a comedown. "No tree in the neighbourhood reached 300 feet." The Hon. James Monroe, Premier of Victoria, thereupon offered a reward of £100 out of his own pocket for any Victorian tree 400 feet in height, *and the reward has remained unclaimed to this day*. Another man claimed to have found a tree there 525 feet high ; but it turned out that the above-mentioned tree was the one referred to. . . . Prof. Sargent is an eminent authority ; . . . . and in view of the actual measurements that he presents, *viz*., 340 feet in height for a redwood and a girth around the trunk of 107 feet for its congener, the " Big Tree, " I am of the opinion that so far as our knowledge goes at present, California is the home both of the tallest and the broadest trees in the world. (1905.)

When the highest living Australian authority gives the banner to the United States, why should it not be accepted ?— [FREDERIC W. GODING, *Consul-General*, Guayaquil, Ecuador, in the *Scientific American*.]

ANT REPELLENTS.

Readers who inhabit ant infested countries may be glad to know that, according to the investigations of Messrs. W. Newell and T. C. Barber on the Argentine ant (U. S. Department of Agriculture, Bulletin No. 122), dry corrosive sublimate may be used to prevent ants from making their way on to the tables, chairs, shelves, and other furniture of dwelling-houses. The method of use is to soak cotton tape an inch wide in a saturated solution of corrosive sublimate, allow it to dry, and then fasten it around a table-leg or on the edge of a bookshelf, etc. If the tape remains dry it serves for months as a repellent to ant invasions.—(*Gardeners' Chronicle*, 8th Nov. 1913).—[*Tropical Agriculturist.*]

EXPLOSION OF PAPER DUST.

Mr. Bonn, Manager of the Lille Municipal Laboratory, directs attention to the explosion of paper dust which occurred whilst cleaning out a dust room in a Tourcoing Paper Tube Works.

At this works pasteboard reels are made for weaving and spinning. These reels, in the form of a long truncated cone, are made by cutting out sheets of paper and pasting them together. With some rather thick kinds of paper the edges must be thinned down before pasting. This is done with abraiding machines consisting of two grindstones revolving at a velocity of 1,200 revolutions. The dust is drawn away by suction through wire gauze by a fan, and settles in a dust room. At Tourcoing the abraiding machines produce 100 kilogrammes of dust daily and the dust room has a capacity of 200 cubic metres. Every week the dust amounting to 600 kilogrammes is removed with a shovel and the gauze is cleaned.

It was during this cleaning that a violent explosion occurred, causing the death of two workmen. The place was lighted by two lanterns, and the work had been executed in the same way for eight years. This dust contained 82·65 per cent. of combustible material. Experiments made at the Liévin Experiment Station

demonstrate that the degree of inflammability of this dust is the same as that of coal dust from the Liévin coal mines. Consequently precautions must be taken and employment of lamps with naked flame prohibited.—[*Paper Trade Review*.]

THE KILLING OF WEEDS IN LAKES.

According to the *Gardeners' Chronicle*, sulphate of copper to kill weeds in ponds must only be applied with the greatest caution to ponds or lakes containing fish, some of which seem to be sensitive to sulphate of copper. It would not be advisable to treat any fish pond in this country even with a very dilute solution, such as one part in 5,000,000, without first determining by experiments with one or two fish in a few gallons of water the susceptibility of each species. It has been found, however, that during the last two summers sulphate of copper applied to the water in St. James' Park has proved to be not only harmless, but even beneficial to the fish. In former years many had been found to be badly attacked by a fungus, but at the last cleaning out the fish were found to be quite free from the fungus disease and remarkably clean and silvery. In cases reported upon they have not been injured by this method of treatment.—[*Pharmaceutical Journal*.]

TRYPSIN OF *CALOTROPIS PROCERA* AND ITS ACCOMPANYING POISON.

The latex of *Calotropis procera* contains a ferment which coagulates boiled milk, digests casein and fibrin, and is very resistant to heat: it is more active in an alkaline than in a neutral medium. It can be separated only with difficulty by dialysis, and is then much weaker than the original juice. When precipitated by alcohol, it is still less active. It is extremely sensitive to the presence of salts of silver, copper, mercury, gold, or platinum: also to halogens, hydrogen peroxide, and the albuminoids of milk coagulated by heat. The presence of minute traces of these

substances will arrest its digestive action, and a quantity which will coagulate boiled milk in three minutes has no action on the same in the raw state When injected hypodermically into the rat, the trypsin causes a very rapid loss of hair over the site of injection. The epidermis is disintegrated in half an hour, and the dermis appears inflamed and exudes a blood-stained serosity. On incision into the lesion, the cellular tissue is seen to be œdematous and gelatinised with intense vasodilatation; and the muscles in the neighbourhood are partially destroyed by the digestive action. But the action is purely local. A scab forms, process of healing sets in, and all the rats treated recover perfectly without showing any functional disturbances. In the guinea-pig, however, hypodermic injection of the ferment at first causes no marked local effect, but the respiration is rapidly increased, followed by dyspnœa, convulsive trembling, and paralysis, and death ensues in about thirty minutes. Pigeons, frogs, tortoises, fish, and cuttlefish are also rapidly poisoned by injection with the ferment Even after the solution has been heated to 100° C. for thirty minutes it retains its toxic action for these animals; while rabbits and chickens share the rats' immunity from more than local symptoms. The poisonous substance is soluble in alcohol 90 per cent, and the solid extract thus obtained dissolved in physiological solution shows the same selective toxicity and produces precisely similar effects Not only is there a marked difference in the action of the poison on animals of different classes, but even in such closely allied species, among the rodents, as the rat and the cavy, it is fatal only to the latter. The ferment of *Calotropis* cannot be deprived of its toxic substance by treatment with alcohol, since that solvent destroys the enzyme.—C. Gerber and Flourens (*Comptes rend.*, 1913, 157, 600).—[*Pharmaceutical Journal*].

WHICH END OF A POST SHOULD BE UP?

It is a very common belief among farmers that a post will last longer if set in the ground the reverse of the way it grew in the tree, in other words, with the butt end up. Accordingly, one sees many posts, especially end and gate posts, with the small end down. The supposition is that sap in a tree is always ascending or at least that it is easier for the sap to go up than down. Consequently, it is argued, turning a post upside down tends to prevent the rise of water, helps to keep the wood dry and therefore renders it less liable to decay. As a matter of fact, sap or water can flow in either direction with equal facility and the popular notion to the contrary is incorrect.

Careful experiments on the relative durability of post timbers have been made by the Ohio Agricultural Experiment Station and the above question was considered. One fence in particular contained 156 black locust posts, of which 86 were set with the top end up, 39 with the top end down, and 31 did not show in what position they were set. At the end of 20 years 30 posts, or 19 per cent., were decayed. Of this number 15 were top up, 13 top down, and 4 undetermined In other words one-third of those set top down rotted off, as compared with only a little over one-sixth of those set top up. From this and numerous other observations the conclusion was reached "that there is no difference which end is put in the ground, except that the sounder or larger end should have the preference."

The decay of a post is mostly at the ground line, since it is there that the conditions as to air and moisture are most favourable to the development of rot-causing fungi. Other things being equal, the larger the post the longer it will last. Inverting a post often means putting the small end in the ground, and where this is done the time required to rot it off is less than where the big end is down. If both ends are equally sound the larger should go in the ground. If one end is defective it should be up, since the conditions above ground are many times more favourable to durability than just at or below the ground line [*Scientific American.*]

ROSIN AND TURPENTINE IN 1913.

TURPENTINE.

In their annual report on rosin and turpentine, Messrs. James Watt and Son, of 101, Leadenhall-street, London, E. C. state that the salient event of 1913 in the naval stores world was the announcement of the liquidation of the American Naval Stores Company at Savannah on March 17th last. So unexpected was this collapse of an organisation which had dominated the turpentine and rosin trade for over a decade, that for a time the markets of the whole world remained stunned by it, and its effects will yet be felt for many a long day. It was soon realised that its immediate cause was rosin rather than turpentine. The "débâcle" in turpentine, due to the unhappy adventure of 1910-11, had already happened when the crisis of March 17th came, whereas at that date unwieldy stocks of rosin were still being carried at highly inflated prices. Nevertheless the London turpentine market was much shaken, and it continued to droop until August last, when *27s. 3d.* was quoted. At this juncture, with a view to uplifting turpentine from the "slough of despond" into which it had fallen, some of the factors at Savannah and Jacksonville intervened, and by their energy and resource they succeeded in putting fresh courage into the market. New distributing companies were organised. Large purchases were made in London for 1914 delivery, followed by bold bids for round lots on the spot, with the result that to-day's price in London is nearly 20 per cent above that of last August, in spite of the record supply.

The wood turpentine industry has been in sore plight during 1913. The American wood distilleries could not fight against gum turpentine at 36 cents, and most of them have ceased working, although the largest and best-known company, the Yaryan, is still in being. Whether 43 cents for gum turpentine is capable of reviving the American wood distillation industry is a question of much interest, for on the answer to it the course of the market in 1914 largely depends. The imports of American wood turpentine into the United Kingdom were probably larger in 1913 than 1912, but as our Customs does not distinguish between wood and gum

spirits in its entries, this is only a surmise. The imports of Russian wood turpentine fell off in 1913 The exports of turpentine from France were much larger, and Great Britain seems to have received the bulk of the increase.

Imports into Great Britain from all Countries.

From	1910.	1911.	1912.	1913.
United States	18,254	18, 81	28,757*	23,820*
France	1,138	1,183	899	1,683
Portugal and Spain	339	260	313	295
Russia, Scandinavia, etc. ..	3,777	4,344	2,798	1,769
All other Foreign Countries	94	38	44	450
Tons .	23,612	24,006	32 811	28 017

ROSIN.

The crisis of last March at Savannah has had a far more marked effect on rosin than on turpentine prices. The quotation for F. rosin on March 14th, 1913, was $5·95 ; by December 31st it had fallen to $3·75, a fall of $2·20 per barrel ; W. W. has only declined from $7 85 to $6 85, or $1 per barrel Present prices for dark grades of rosin, unlike those of turpentine, are above the average of the past decade ; they would have been deemed extravagant at any time between 1870 and 1905. The high price of dark grade rosin since 1905 has killed some industries, and forced others to use it either sparingly or not at all ; while the high price of pale grades of American between 1906—1912 doubled the imports to the United Kingdom from the countries other than United States. The uses for the dark grade rosin are, however, so widespread and so capable of expansion, that possibly the fall already recorded may be sufficient to revive the demand for them.

Imports into Great Britain from all Sources.

From	1910.	1911.	1912.	1913
United States	48,381	50,084	50,763	66,651
France	16,987	13,250	17,742	9,672
Spain and Portugal	8,160	8,644	10,091	8,350
All other Countries	1,503	2,288	3,471	3,230
Tons ...	75,031	74,271	82,060	87,903

[*The Indian Trade Journal.*]

* Including wood turpentine in 1912 and 1913

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TEAK IN THE WYNAAD: A STUDY.

PART II.

[*Part I appeared in May* 1914.]

K.—STEM ANALYSIS OF THE MATURE TEAK

21. As the figures are available, a few remarks on the Stem Analysis may be welcomed by those interested in the study of Teak.

22. The fellings are carried out as follows: The laying out of the coupe and sub-coupe boundaries is done the year previous to the felling of the coupe. The trees to be felled are also marked a year in advance of the actual felling. The Marking Register forms the basis of the Felling Register. As soon as a tree is marked, it is entered in the register, together with its breast-girth; eight lines are left blank between each such entry in the Marking Register. Each tree marked is given a serial number which runs through the whole coupe and the "remarks" column shows the reason why the tree was marked for felling (dead, dying crooked, etc). Every tree marked for felling is hammer-stamped at its base. Trees reserved as seed-bearers are marked with red lead and entered in a separate register.

In the following year as soon as each tree is felled, the tree number is transferred at once to the stump and the butt end of the tree. The total height of the tree, its middle girth, the bole height and the middle girth of bole are measured and entered in the Felling Register (which is the previous year's Marking Register). The bole is then cross-sawn into logs, each log bearing on its lower butt, the tree number, and the log letter a, b, c, etc. (the lettering commencing from the bottom log and proceeding up the tree for each log) which is painted in Tar on to each log. Similarly, the top and branch wood is logged, each such piece bearing the tree number and the branch letter (the lettering being continued on from the last bole letter). In the "remarks" column the word "branch" is entered opposite each such log in order to distinguish it from a bole log. All logs are then axe-squared, the year of felling, the coupe and sub-coupe number, the species, the tree number and log letter are then chiselled on the drag hole end of the log and on the same face. The contents of each log are entered in the Felling Register; in order to avoid any future dispute or unreasonable grumbling, the two points, where the measurements are taken and the middle line where the middle girth is taken, are marked by chiselled lines cut into the face of the log. In the case of very large diameter trees, the logs have to be further sub-divided by means of longitudinal saw cuts: in which case, each half of the original log bears its lettering and the figure 1, 2 according as it is the right or left longitudinal half. Cases have even occurred where it has been necessary to saw a log longitudinally into four smaller logs, the lettering for each of these logs being then a1, a2, a3, a4.

It will thus be seen that the Marking Register of one year develops into the Felling Register of the following year, and it is to admit of this that eight lines are allowed between each entry of the Marking Register, to give room for the entries of the log statistics when the felling takes place

The logs are then dragged by elephants to the Forest Roadside Depôts where they are measured by the Ranger, given a Depôt number (which is chiselled below the other figures men-

tioned above) and entered in the Depôt Registers. These are the final and Departmental measurements on which sales are based For cross reference, the depot number of each log is entered in the "remarks" column of the Felling Register and the Depot Register contains the Felling Register tree number and log letter of each log. The logs are then taken to the Sale Depôt, where they are arranged in lines according to their species. If the work is to proceed smoothly and to minimise the changes in Establishment, it is very necessary to have the lines (Kalangis) in the sale depôts arranged at equal distances apart, with a board at the end of each line displaying the line number, the species it is intended to store and the number of logs which the line will reasonably contain. An accurate sketch of each sale depôt, together with the information regarding its storage capacity, will be found to be of great assistance.

It is thus possible to trace every log from its stand in the forest to the moment of sale or, if necessary, to the moment it is sawn up into scantlings and *vice versa* It is also known exactly from what portion of the standing tree the log came from. The whole procedure is exceedingly simple in practice and can be carried out by any one who can read and write (trained or untrained) who chooses to take the trouble to read the rules drawn up and issued for guidance in the Range Manuals which have been issued in this District. In practice the work (except the marking) is done by one Deputy Ranger or Forester and two Guards who are thus occupied for 4 to 5 months. This Establishment is necessary in any case to control the work. But instead of being allowed to report each week that they have "Supervised the Fellings" and interpreting that expression according to their own ideas, their time is fully occupied and usefully mapped out for them; and the result of their "Supervision" remains as a permanent record of great value After tabulation, the Felling Register is recorded in the District Forest Office. It will perhaps also be needless to add that this system was not introduced in a day nor has the actual work proceeded so smoothly as the above description would indicate. This is due chiefly to changes in

Establishment, and partly, of course, to the fact that time and patience is required to transform a new procedure into a routine system. It will require another fifteen years before the figures obtained can be presented as statistics. The foregoing description will satisfy the reader that great pains have been taken to secure as accurate results as possible and the figures as obtained up to date are presented below —

TABLE VIII.—*Average linear measurements of Mature Teak.*

Range.	No of trees measured.	Average height of tree in feet.	Average breast-girth in inches. *With Bark.*	Average length of bole in feet.	Average middle girth of bole in inches. *With Bark.*	Percentage of bole to height of tree.
Begur ..	875	61' 4"	98"	32' 5"	77"	52·73
Chedleth .	1,278	70' 7"	91"	29' 11"	78"	42·35

At the time of marking, the worst trees are supposed to be marked and the best trees left as seed-bearers. No trees under 2 feet in diameter are to be marked, unless they are dead, dying or very crooked. It is clear from the above that the forests are overmature and are being deliberately worked as they are with this knowledge. It is clear also that Tables VIII, IX, X and XI do not represent the best possible results, since the best trees are deliberately allowed to stand in order to make matters easier for a future generation. Although several theoretical objections can be brought against such a course of action, it will in practice be extremely foolish to depart from this policy, until—

(*a*) The statistics now being collected are sufficiently developed to have become a sure guide on which to base a new departure. For without reliable statistics one is actuated entirely by guess work in applying theoretical doctrines, and

(*b*) The results of *rigid fire-protection* have been tested for a sufficiently long period to enable the manage-

ment to assess its influence on Natural Reproduction with a view especially to its effect on Reproduction from Seed.

23. Teak is by no means the tallest tree growing in the forest. For by similar figures obtained for other species, the average results are :-

TABLE IX.—*Height-growth of certain species.*

Range.	Teak.	*Dalbergia latifolia.*	*Lagerstroemia lanceolata.*	*Terminalia tomentosa.*	*Pterocarpus Marsupium.*	Red Cedar.
Begur ...	61' 4"	61' 11"	68' 4"	72' 11"	67' 1"	...
Chedleth ..	70' 7"	81' 2"	79' 3"	83' 11"	74' 0"	91' 5"

The highest individual averages in any one year, in a coupe, have been :—

L. lanceolata	...	79' 4"	(Chedleth).
D. latifolia	..	83' 2"	(Do.)
T. tomentosa	...	96' 11"	(Do.)
P. Marsupium		81' 11"	(Do.)
Red Cedar	..	91' 6"	(Begur).

While the highest teak average has been only :—

Teak	...	72' 4"	Chedleth.
Do	...	64' 4"	Begur.

All this one knew before. But statistics, which are properly and correctly organised and tested, transform what would otherwise only be belief into accurate knowledge. The six highest individual Teak trees have measured 140 and 128, 136 and 118, 130 and 114, 126 and 110, 122 and 109, and 121 and 104 feet respectively (for Chedleth and Begur). Of the trees of all species, the Teak, 140 feet in height, has been the tallest tree which has been felled up to date.

24. All merchantable timber in North Malabar is axe-squared. In the following and any other tables wherever the comparison may be necessary, the figures given for Square measurements may be converted into their corresponding Round measurements by adding roughly 1/5:—

TABLE X.—*Average cubic measurements of Teak*

Range	C. Contents with reference to breast girth to height of tree.	C. Contents of dressed and squared logs per bole.	C. Contents of tops and lops squared per tree	Percentage of tops and lops to bole timber.	Total merchantable squared timber per tree.
	C. ft	C. ft.	C. ft		C. ft
Begur ..	354·61	66·46	15·92	29·18	82·38
Chedleth	316·75	50·60	9·49	18·54	60·09
For round measurements by adding 1/5 we obtain:—	Begur	79·75	19·10	35·01	98·85
	Chedleth ..	60·72	11·38	22·24	72·10

The much greater size of the Begur trees corroborates the lesser number of trees per acre (together with the greater number of the bamboo clumps) as arrived at in para. 13. On the other hand, the Chedleth trees having a 15 per cent greater height-growth than those of Begur might be expected to produce more timber; whereas, on the contrary, a Begur tree yields nearly 27 per cent. more timber with a greater 8 per cent of breast-girth.

25. There seems to be a general impression in the Department that it is useless to endeavour to collect reliable Form Factors for the more important species which we have to deal with, when grown in mixed forests. But the term Mixed Forests when applied to India is so vague, that an idea or a principle which is quite premature in one locality may be one which has become long overdue in another portion of the enormous area embraced under the geographical name of India. It may be also that the impression has gained ground owing to the Statistical Branch of Forest work of India having been so woefully neglected

hitherto. This, of course, is tantamount to saying that although very good progress has been made in the work of administration, organisation and finance, we have as yet very little progress in real Forestry to show, as the result of thirty years' work as a scientific department. The annexed table indicates an average Form Factor for Teak based on returns as scheduled up to date.

TABLE XI.—*A tentative Form Factor for teak as applicable to North Malabar.*

Range.	Form Factor for total merchantable squared timber on a breast-girth basis.	Form Factor for merchantable squared timber on a breast-girth basis for	
		Bole timber.	Tops and Lops.
Begur ...	·26	·21	·05
Chedleth .	·21	·18	·03

This result is of course at present interesting, chiefly from an academic point of view. Form Factors for Mixed Forests must be prepared for local use. Further, a single average figure will only hold good when dealing with a large area. Consequently any local results obtained must be further averaged by girth classes and by soil ($\frac{\text{or}}{\text{and}}$ other local factor) classes.

26. To those Foresters who possess an open mind on the subject, the following little table will be interesting, as tending to show how valuable even a tentative result may be, and how a rough figure, though it falls manifestly far short of the ideal, may prove a great safeguard in the case of a Department which has not yet awakened to the value of, and necessity for, that kind of statistical information which is the basis of all progress and the absence of which results, in addition, in the non-collection and loss of control of much legitimate revenue :—

TABLE XII.—*Error in Estimating Yield.*

Year.	Begar Range.			Chedleth Range		
	Estimated yield.	Actual outturn.	Percentage of error of estimate.	Estimated yield.	Actual outturn.	Percentage of error of estimate.
	C. ft.	C. ft.		C. ft.	C. ft.	
1908-09	27,082	46,047	−74%		23,207	..
1909-10	38,000	41,608	−9%	..	29,232	.
1910-11	23,430	19,900	+15%	..	19,571	..
1911-12	43,290	59,941	−38%	27,195	40,993	−50%
1912-13	24,789	39,631	−59%	31,360	47,812	−52%
Total	-	207,127	..	..	160,815	..

There are two simple methods by which standing timber may be disposed of. A coupe may be sold standing in the mass, or it may be sold on the understanding that payment shall be made at so much per cubic foot of the actual outturn obtained. In the former case both the Department and the contractor are working wholly by guess work, unless some reliable estimate can be made beforehand. Without the means of making such an estimate, the sale is a pure gamble on the part of both parties and the better class contractor is discouraged. In the latter case, both parties know that they are working on a definite basis and mutual confidence results. But even in the case of the cubic foot basis, a reasonably reliable estimate is advisable; for the Department can make a more accurate forecast of its revenue for the coupe (the marking being done a year before the sale) and the contractor is in favourable position for calculating the capital he needs and the scope of the arrangements he must make for labour, elephant hire, carting, floating, etc., together with the amount he must risk in "Advances" for the various items which the custom

of the country demands. The same argument applies to Departmental working. Besides all this, if a respectable contractor feels he can rely with some degree of confidence on Departmental estimates, he will increase his tender to the highest possible point when replying to calls for contracts. Good estimating then acts both ways. It cuts down expenditure and increases legitimate revenue. It ensures good relations between the department and its contractors, and encourages respectable contractors to come forward, because such men know that they have a fair chance of competing against gamblers and men of straw.

Fortunately, in Chedleth, the cubic foot system has been in force throughout the period covered by Table XII. In Begur the lump sum method was adopted in 1908-09, 1909-10, 1911-12; Departmental working in 1910-11, 1912-13.

It may be objected that the estimated yield should have been based on the statistics available. The reply is that the statistics were not ready. Under existing conditions, it is difficult enough to collect any figures at all. To put them together in a statistical form becomes a very formidable task and one which can only be carried out at odd times, with long intervals between each such opportunity.

27. Here again is a proof of the value of statistics. This seemingly insignificant table which is one of the outcomes of the study of a particular tree in a portion of one District teaches a lesson which is applicable to the whole of India. It shows clearly enough the necessity for the collection of Forest statistics and the necessity for a machinery to put these statistics into a shape in which they can be utilised It proves also that such a machinery would more than pay for itself. For to take only one item, the loss incurred in Begur in 1908, 1909 and 1911 would have more than paid for any establishment necessary to supervise and arrange the statistics which have been obtained.

28. In the immediate future, to return to North Malabar, no reliance will, of course, be placed on the Form Factor method So far as the information is available, we know (*vide* below) the average number of logs per tree in the case of each saleable species

and the average cubic contents of each log, both bole and lops, and tops, and it is on these averages that future estimates will be based. If the collection of these statistics is persevered with, it follows that every five years the figures obtained will become more and more reliable. But there is no reason why, at some future date Form Factors should not be obtained from the more extended data which will then have become available.

L.—TEAK LOGGING

29. The details of breaking up the trees into logs depends chiefly on the facilities for export and transport and the form in which the market requires the product. Such details are therefore more of a local than a general interest. It is probable, however, that this logging depends a good deal more on the convenience of the woodmen and therefore on the efficiency of the supervision than we care to acknowledge The subjoined table is one of great local importance, but it may also possess a more extended interest.

TABLE XIII -*The break up of Teak.*

Range.	Average No. of coolies to fell log and dress a tree.	LOG OUTTURN PERCENTAGE.			Average No. of logs per tree
		Over 40 c. ft.	20 to 40 c. ft.	Under c. ft	
Begur ...	5·07	22·74	26·08	51·18	2·66
Chedleth ...	7·15	6·92	22·62	70·45	3·07

The large number of small logs is partly due to the utilisation of lops and tops which used formerly to be entirely wasted; and partly to a method of classification for sale which is going to be altered.

30. The application of such a table is manifold. It is useful to calculate and systematise the elephant labour for which a

special set of statistics are maintained. It is useful to calculate well in advance the number of carts which will be required, the rates payable and the length of time (and therefore the supervision) required for the carting. Last year, for instance, thanks to the possession of this little table, a saving of 8 per cent was effected in accepting the terms of a contract, although the terms of another would-be contractor appeared at first sight to be the more favourable. A quasi-commercial Department may make light of the means for effecting such a saving on only one of several items in the transactions involved in carrying on its timber business. But a commercial firm would prize highly and use its best endeavour to develop any system which could produce a result of this nature. Such a table too may be used to forecast the labour required for producing the logs. Such a labour calculation is especially valuable in localities where labour is scarce. It enables one also to assess the efficiency of labour. Thus, it is the local custom to pay at so much (10 pies) per c. ft. of logged, dressed and chisel-marked timber. On the surface it does not matter financially how many men are required to do the work and how long they take to do it. In practice it matters a very great deal. Local labour has been calculated to be only half as efficient as Moplah labour imported from the coast. Consequently at the same rates, Moplah labour is much cheaper than local labour. The Moplahs finish the work quicker and hence what are commercially known as the "overhead" expenses are very materially reduced. The immediate local supervision of the work can be reduced from eight months to four months, the share of the cost of supervision of the Ranger and his clerical work, the similar cost of the supervision of the District Forest Officer and his Clerical Staff is reduced proportionately, and these savings, if properly calculated, amount to a good round sum. Moreover, the establishment not only does the same work in a much shorter time, but it is in consequence enabled to utilise the time gained on other works which it otherwise could not have supervised. All this gain in time and money is due solely to a few well-designed statistics, the cost of whose compilation is trifling: the efficiency of the establishment is materially increased,

the individual men work with increased intelligence and even commence to take a real pride in their work.

31. It may be objected that this is a sad digression from a study of Teak. But it is precisely because it is a digression that it contains a very valuable lesson. It proves what a far-reaching effect Forest Statistics may have beyond their immediate object. For this portion of the Statistics, designed with the sole object of gaining some local knowledge of Teak, has had the much wider result of materially saving time and money in other respects in addition to increasing the efficiency of the Forest Staff.

32. In this connection it is not intended to inflict any more figures on the reader. It will suffice to close this part of the subject with one more point. In the process of this statistical study of Teak, another set of figures emerged which has resulted in saving an appreciable percentage of timber (by felling close to the ground: by substituting cross-sawing for axe cuts in the process of logging, and by utilising the tops and lops). It was grudgingly admitted that this wastage was taking place, but the compilation of the figures proved it, and it was only after the statistics had been prepared and issued to the Range Staffs that the waste was put a stop to. There is still a wastage which is believed on well-founded grounds to amount to a further 10 to 15 per cent. of the total outturn of timber (due to chipping the sides of the logs to square them instead of sawing off the slabs). But there are no figures available to prove this belief and translate it into terms of statistics. This wastage lies consequently beyond the immediate scope of a District Officer, and this avoidable waste is likely to continue for some time to come.

In times when timber is rising in price, and in view of such wastages as noted above, rightly applied statistics and adequate means for compiling them are not only a Departmental affair but become a public utility.

M.—THE REPRODUCTION OF TEAK.

33. Some six years back, a certain sum of money was allotted every year for "Creeper-cutting" and 4,000 acres a year were

being treated, which in itself was too good to be true. Here, as in so many other instances, the special study of Teak led to wider-reaching results. As soon as attention was concentrated on the nature of the damage which Teak suffered from climbers, it was quickly ascertained that not only Teak but very few other trees in the forest suffered any material damage at all. As the enquiry progressed, it was discovered that it was not the growing trees but the small plants which were affected by climbers. It was an easy step to divert the money from the trees to the young plants. The problem which then arose was how this money could be usefully spent and a check exercised on the work done. With this object a system was devised which is known locally as the "Skirmishing System." Each operation is in charge of a Deputy Ranger or Forester who works within a prescribed and concentrated area, together with five coolies he quarters the ground allotted to him by walking up and down it in strips, all working in line. As each cooly discovers a young plant (of some 20 chosen species) he calls out his name and the name of the species. The Forester repeats these and books the species. Meantime the cooly frees the plant from the climber (if any) and "grass knife" or "sickles" round the plant to give it light and air. And so on with the other coolies. Only plants of less than 2½ to 3 feet in height are dealt with. The line is halted at frequent intervals to reform it and maintain the right direction. A guide blazes the flank of each strip, so that it shall not be gone over a second time, and in order that no ground may be left out between the strips. One such operation is as far as possible carried out by every Deputy Ranger and Forester once a week. The result of each enumeration is fair copied and sent direct to the District Office, together with a calculation showing the cost of each plant treated where the totals are compiled when a sufficient number of lists from each area have been received. The Range Manual contains full details as to how the work should be done, and it is of such a simple nature that any untrained man can carry it out after being shown once how to do it. The man in charge of the work need not even know the name of a single plant, as the coolies call the names out for him: but, thanks to this

operation, the Upper Subordinate Staff are beginning to recognise the young plants of the more valuable species found in these forests. Not only are many thousands of young plants being saved every year but in a few years' time we shall know with some degree of confidence exactly how the reproduction of these forests stands. The work is at present intrusted only to Foresters and Deputy Rangers, as it is necessary to set up as high a standard of accuracy as possible until the system is well established; but there is otherwise no reason whatever why Guards should not be given the job, as it is well within their competence. The inevitable table of results as acquired up to date in Chedleth Range is given in the shape of—

TABLE XIV.—*Comparative statement of the Reproduction of Teak and other Species.*

	Kurichiyat Reserve.						Mavanhalla Reserve.		Kuppadi Reserve.	
	Pavaguddai.		South of Coupe X		Odapallam					
	Plants per acre.	%	Plants per acre	%	Plants per acre	%	Plants per acre	%	Plants per acre.	%
1. *Dalbergia latifolia* ...	59.24	18.87	11.15	10.35	6.69	8.11	60.45	30.77	14.40	9.64
2. *Terminalia tomentosa* ..	30.82	8.27	8.26	7.67	11.40	13.88	30.39	15.47	13.19	8.84
3. *Pterocarpus Marsupium* ..	78.45	21.01	6.61	6.14	5.71	6.92	20.73	10.55	13.91	9.32
4. *Grewia tiliaefolia* ..	61.71	16.53	4.76	4.42	11.52	13.96	15.66	9.50	12.80	8.58
5. *Anogeissus latifolia* ...	44.96	12.04	1.19	1.10	7.04	8.53	11.08	5.64	0.47	0.32
6. *Tectona grandis* ..	10.16	2.72	7.34	6.85	2.50	3.03	9.71	4.94	0.36	0.26
7. *Eugenia Jambolana* ..	...	...	2.92	2.71	1.87	2.26	8.54	4.35	14.40	9.64
8. *Schleichera trijuga* ..	56.16	15.04	4.34	4.03	5.84	7.07	8.11	4.13	7.38	5.08
9. *Albizzia odoratissima* ..			1.80	1.67	0.19	0.23	6.63	3.37	0.74	0.50
10. *Bridelia retusa* ...	2.84	0.77	3.26	3.03	3.36	4.07	5.96	3.03	9.31	6.24
11. *Lagerstroemia lanceolata* ..	5.95	1.59	4.65	4.69	5.14	6.23	3.57	1.81	7.[illegible]6	4.80
12. *Stereospermum suaveolens*	5.37	1.44	1.88	1.75	1.39	1.69	2.02	1.03	4.62	3.10
13. *Mangifera indica* ...	0.17	0.45	...	...	2.56	3.11	0.46	0.23	10.38	6.96
14. *Vitex altissima* ..	8.04	2.15	...		0.63	0.76	0.21	0.10	1.13	0.76
15. *Adina cordifolia* ...	3.04	0.81	..		1.30	1.57	0.10	0.05	...	...
And 15 other species ...	7.12	1.90	49.47	46.05	17.30	20.97	10.77	5.47	39.35	26.42
Total ..	374.28	.	108.23	...	84.63	..	[illegible]97.48		149.64	...

For reasons, not necessary to detail here, the Skirmishing System was at first only applied to Chedleth. It has recently been extended to Begur, but no sufficiency of figures for that Range have been gathered to warrant their publication. Of the three areas mentioned, Kurichiyat is in the merchantable Teak Zone, Kuppadi and Mavanhalla are in the merchantably unworkable Teak Zone.

34. It is a fortunate thing that in 1901 an enumeration of the reproduction was taken for the purposes of a Working Plan. In that year only nine species were separately enumerated For the sake of comparison, the same nine species are taken out of Table XIV and shown again in—

TABLE XV.—*Comparison of the state of the Reproduction in 1901 and 1912.*

Species.	Kurichiyat. Average No. of plants per acre		Mavanhalla. Average No. of plants per acre.		Kuppadi Average No. of plants per acre.	
	1901	1912.	1901.	1912.	1901.	1912.
Teak ...	2·01	6·67	3·61	9·71	0·38	0·36
P. Marsupium ...	2·06	30·25	2·14	20·73	3·06	13·91
D. latifolia ...	5·73	25·69	2·94	60·45	4·44	14·40
L. lanceolata ...	0·12	5·26	0·01	3·57	0·04	7·16
T. tomentosa ...	2·93	16·85	2·54	30·39	3·10	13·19
A. latifolia ...	0·28	17·73	2·25	11·08	.	0·47
A. cordifolia ...	0·03	2·17	0·10	0·10	..	...
B. retusa ...	0·98	3·15	2·11	5·96	0·61	9·31
Total	14·12	107·77	15·71	141·99	11·63	58·80

So far as Teak is concerned, Kuppadi may be considered as a check area. It has only come under successful fire-protection during the past four years. Kurichiyat has been under rigidly

successful protection for ten years, and protection was attempted prior to that time. Mavanhalla has been under similar protection, and although the protection in the south and south-west portions of this reserve has been a complete failure, the portion in which the enumeration has been made has been successfully protected, with the exception of one fire (of 20 acres). Under existing conditions, all statements which are made with respect to the success of fire protection ought to be made and received with very great caution. With this warning, it is believed that the statement made regarding the protection of these areas is as correct as can now be arrived at.

With regard to Teak, it would seem that four years' protection from fire has no apparent effect on the reproduction, but that in ten years, the cumulative benefit to the soil has improved the reproduction to the extent of 300 per cent. This latter figure takes no account of the plants over 3 feet in height which have grown up in the immediate period. Kuppadi is thus an area worth watching, and the figures obtained regarding the Teak in the 6th, 7th and 8th year of its protection will be particularly important as these seem to be the critical years when the first visible improvement may be looked for.

Of the species which have shown most improvement in this Table, *P. Marsupium* reproduction has been mostly from seed, that of Teak, *Dalbergia latifolia* and *Lagerstrœmia lanceolata* nearly entirely from root-suckers, while *Terminalia tomentosa* reproduces with equal facility from seed and root-suckers.

35. Seeing that Teak may reproduce itself from coppice, root-suckers and seed, it is important to clearly specify to which of these three categories the above reproduction belongs. Briefly it may be stated that some of it is from coppice, nearly all of it is from root-suckers and scarcely any of it is from seed.

M (a).—THE REPRODUCTION OF TEAK FROM ROOT-SUCKERS.

36. Wherever there are open spaces in Teak zones, it may be observed that young Teak often comes up freely in such spots. This has given rise to statements which one so frequent-

ly hears made that all that is required for the reproduction of Teak is to open out the forest. When this theory is blindly put into practice and failure results, some people attribute the failure to fire-protection and others to want of fire-protection and both parties are satisfied not to look beyond these two Shibboleths for the real causes of the failure. It seems to be generally accepted also, that this regeneration is produced as seedlings. This belief again has given rise to the idea that Teak seed has a peculiar faculty of lying dormant for many years and germinating as soon as the conditions become favourable (the truth being that Teak seed deteriorates by keeping and is peculiarly liable to insect attack; it is also very susceptible to wet rot). Without qualification, the above statements are incorrect. They rest on false premises and have led to erroneous conclusions.

Wherever there is reproduction of the nature referred to, an exploration of the adjoining wooded area will show that similar reproduction can be discovered in these places wherever the trees have been felled. In both cases this regeneration is found in little patches or groups, not because, as some people have supposed, Teak is a semi-gregarious tree, but because these patches are brought about by the growth of root suckers from the parent roots. Sometimes it is true that only what appear to be single stems may be seen; but these are the forerunners of the remainder of the group. When these little patches occur in the open, they at once catch the eye, whereas search is necessary to detect the exactly similar patches in the wooded parts. Further, as Teak is a deciduous tree, such search is best made when the plants are in full leaf, otherwise it is easy to miss the bare unbranched stems of the young plants among the other surrounding and more conspicuous growth. So, the fallacy has arisen that because one may see young Teak plants in open spaces, one has only to open out the forest to secure them in other places. When, in addition, it is assumed that the plants have arisen from seed, the fallacy becomes a double one. To argue in this manner without some very strong additional grounds which are justified by the conditions of the locality, and which

must be expressly stated in each case, is to commit a very grave sylvicultural error. To act in accordance with this false reasoning may result in the destruction of a valuable canopy only to invite a dense growth of some undesirable vegetation to take its place and which will preclude any hope of the appearance of Teak until this new element in the situation has disappeared

The Teak does not grow in patches, because it particularly wishes to do so, but because the soil conditions are such as to preclude its equal desire to reproduce itself from seed.

There is no necessity to "open out" the Forest to secure the growth of root suckers, as they will come up in any event and wherever there is an existing root system, as soon as the soil conditions allow them to do so. The time to commence clearing the overhead and side cover is when the young plants are 3 to 4 feet high and not before this stage. Even then it should only be done gradually and by little at a time. Of the two alternatives it is safer to leave the cover untouched rather than to remove it too quickly or too drastically.

The above remarks may not be acceptable to the reader, but if they are true, the latent vitality resides not in the seed of Teak but in its root system. As soon as this proposition is generally recognised, we shall have taken a long step forward in our management of the tree and save a good deal of useless expenditure and disappointment.

M (b).—Reproduction of Teak from Coppice.

37. The subject of coppice is eminently one for Statistical Research, especially as doubts have been formulated as to the wisdom of cutting flush with the ground. It has also been maintained that when coppice shoots are allowed to grow into large trees, the timber obtained from them is inferior to that grown from seedlings. Heterodox views are calculated to stimulate the progress of Indian Sylviculture, provided that such views are supported by some reasonable evidence and provided that this evidence can be immediately investigated by a properly constituted branch of the Department.

When the study of Teak commenced in the Wynaad, the question of coppice received some attention, but owing to the pressure of more immediately important details, circumstances have prevented this subject being given the attention which it otherwise would have received. For instance, the statistics were planned to keep track of every tree felled and, among other items, it was intended that the diameter of the stump, when its coppice shoots were examined, should always be noted. This has not been systematically done. The following table, though valueless in this respect, brings out an interesting point. It is stated in para. 32 that the proof of the waste involved in cutting trees at some distance above the ground, brought about a concentrated effort to fell them as near the ground as possible. The object of this change was primarily intended to obviate a needless and appreciable waste of timber. A secondary benefit has, however, accrued, for the table shows clearly enough that the increase in the percentage of stumps which have coppiced according as they are felled close to the ground, over these stumps which failed to do so, has been very noticeable. Teak, therefore, is a species which must be felled close to the ground and the closer it is felled, the better will it coppice.

TABLE XVI.—*Percentage of Teak Stumps which have Coppiced.*

Coupe No.	Year worked	No. of trees marked.	No. of stumps which coppiced	Percentage of stumps which coppiced to stumps which failed.
Begur Range.				
Coupe VII ...	1909-10	133	21	15·78
" VIII ...	1910-11	67	50	74·62
" XVI ...	1911-12	273	148	55·70
" XVII ...	1912-13	146	83	56·85
Chedleth Range.				
Coupe IX (I Part) ...	1908-09	190	42	22·46
" (II Part) & Coupe X (A & B).	1909-10	216	75	34·72
" X (C to G). ...	1910-11	201	85	40·30
" (H. to M) ...	1911-12	383	240	62·66
" III (A to F) ...	1912-13	295	191	64·74

38. Incidentally also, the table again brings out the contention that the collection of statistics—apart from their own intrinsic value—actually has a money value and improves the efficiency of the staff. Once the range establishments were given undeniable proof in the form of statistics which they knew to be accurate, of the waste of timber which had gone on year after year, they loyally set themselves to prevent it and the increasing percentage of stumps which are coppicing which is due entirely to the better supervision and the cordial co-operation of the range staffs—is a very satisfactory testimonial that statistics have a very large money value, as quite distinct from their absolute necessity to a department which intends to make any progress in the scientific side of its work. Thanks to the statistics collected and circulated on the subject, the money value of the timber saved on the three processes, named in para 32 in this one Taluq alone would have gone appreciably towards the cost of a complete and equipped statistical branch for the whole Presidency.

39. In the case of Wynaad, it has not been necessary to enter into the question of the relative value of coppice timber as compared with seedling timber. Ever since 1860 when records of prices became available Wynaad Timber has always obtained as high a price as any other timber it has competed against, and in view of this practical test of the value of coppice timber any theories to the contrary may be ignored. But for purposes other than the contention that coppice timber is not so useful as that from seedlings, it was found necessary to collect a few figures to ascertain the origin of the existing standing crop of Teak in the Wynaad. A mere glancing passage through these forests suffices to satisfy one that many of these over-mature Teak trees have undoubtedly resulted from coppice in consequence of the shifting cultivation to which all these forests have been subjected and that many more of the trees have probably so resulted. To test how this would work out, it was decided to count the trees in a coupe. In order that there should be no doubt about the matter, only those trees which produced two stems from the ground were to be counted and all other trees were rigidly excluded, however

patent to the eye it might be, that they too were of coppice origin. Of 582 trees tabulated, 47 or 8·07 per cent. were of this undeniable coppice origin. Five species were enumerated and of these 18 were Teak, 13 were *P. Marsupium*, 5 were *D. latifolia*, 5 were *L. lanceolata* and 6 were *T. tomentosa*. The enquiry having served its purpose was then abandoned.

40. For yet another purpose, of these 582 trees, the stumps of 7 of these same Teak were among others examined five months after they had been felled. They gave the following result :—

TABLE XVII.—*Diameter of Teak Stumps which Coppiced.*

Range and Coupe.	Tree No.	Original diameter of coppice stems		Height of new coppice at 5 months old.		Number of coppice shoots per stump.
		Ft.	in.	Ft	in.	
Begur Coupe VII ..	11	3	5	2	4	12
	45	4	4	3	4	13
	46	4	6	3	1	12
	47	3	0	2	3	11
	66	4	1	3	3	12
	84	2	0	2	9	12
	109	6	4	3	4	12

The interest of this table lies in the fact that the original stumps of trees whose coppice shoots had obtained the respectable dimensions of 82—93 and 89 feet in height and of 4′ 4″, 4′ 6″ and

6′ 4″ in diameter, were each immediately able again to produce a number of coppice shoots which attained within five months a height of 3 feet.

41. To carry this table a step further, it is possible to make a reasonable guess at the age of these coppice trees. The word "guess" is used advisedly because, although it is not disputed that Teak puts on one ring a year, it is not yet known how much allowance ought to be made for the "pith." The usual European allowance of five years for the pith seems meagre for Indian trees of 2 feet in diameter, much less will it do so for trees $3\frac{1}{2}$ ft. and $5\frac{1}{2}$ ft. in diameter. Ring countings in Begur have given 70 to 150 years and a mean of 104 years for a Teak tree to attain 2 feet in diameter. Allow ten years for the pith and 6 inches for the (diameter) bark. Trees of $3\frac{1}{2}$ and $5\frac{1}{2}$ feet in diameter without bark would be somewhere in the neighbourhood of 150 to 280 years old in round numbers or a mean minimum of 200 years. This bears out the contention in para. 36 that the root system of teak has a great vitality, since stumps of trees of 200 years old and perhaps a good deal older can throw out some 12 coppice shoots immediately they have been felled. Another stump of a tree which measured 97 inches at breast-height girth actually yielded 22 coppice shoots. These trees were felled in the months of August, September, October and November, *i.e.*, during the South-West and North-East monsoons.

(*To be continued.*)

F. FOULKES, I.F.S.,
N. Malabar.

LIST OF THE TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN FOREST CIRCLE OF THE C. P.

(PART IV.)

BY H. H HAINES, I.F.S.

[*Part I appeared in October* 1912, *Part II in February* 1913, *and Part III in May* 1914.]

XXVIII.—RHIZOPHORACEÆ.

Carallia lucida, *Roxb.* Karalli *Tel.*

A moderate sized tree, attaining 5 ft. girth but not tall, with smooth grey bark and hard red blaze. Twigs somewhat 4-angular. L. opposite shining leathery 3 by 1·3" to 6 by 3·2" quite entire obtusely cuspidate with numerous close fine oblique sec nerves reticulating within the margin. Leaf buds ·5—·75" long acuminate wrapped in the caducous stipules. Petiole ·25—·5". Fls. small greenish sessile in stout dense axillary 2-3-chotomous cymes 1—2" long. Petals inconspicuous white erose. Fr. ·25 globose coriaceous

Fls. *Dec.—April.* Fr. r.s. Evergreen. New leaves in March and April.

Only along flowing streams in Ahiri (Venkatapur) and Sironcha range (S. Ch.).

(I have given the usual Telegu name on account of its showing the derivation of its scientific name, but no native in Sironcha could name the tree).

XXIX.—COMBRETACEÆ.

Most of the **Terminalias** have two large glands at the top of the petiole or on the base of the leaf.

Terminalia tomentosa, *W. & A.* En (sometimes spelt Ain or Yen), Saj, *H.*; Marda, *Gond.*; Maddi, *Tel.*

A small or large tree according to locality, with grey black bark deeply cracked into squares or oblongs, crimson blaze, opp. or sub-opp. ell, or ell-obovate or oblong leaves more or less pubescent

or tomentose beneath, small greenish-white flowers in panicled spikes and a 5-winged fruit 1·5 –2″ long or more, wings over ·5″ broad with horizontal striations.

Fls. *May-June*. Fr. *Feby.-March*. Deciduous *March – May*.

Common in all soils and situations. One of the trees prevalent on cotton soil on which, however, it is usually small. Attains large girth (8 –9 ft) in narrow valleys. Reproduction excellent, but in unfavourable localities the seedlings may apparently take twenty years or so to get up, forming in the meantime bushy clumps of shoots. The ultimate stem is frequently a sympodium. Pollarded for the tusser Silk-worm.

NOTE.—A so-called 'shrub' forwarded by Mr Rama Rao in flower from South Chanda, was probably a coppice shoot. It is certainly T tomentosa.

Terminalia Arjuna, *Bedd.* Arjan, *H.;* Anjan, *Mar.;* Kohwa, *Chh.;* Mangi, *Gond;* Tela-or Yer-maddi, *Tel.*

A large tree with smooth pale grey bark, crimson blaze distinctly zoned, oblong glabrescent leaves 2 -3-times as long as broad, or elliptic at base of shoots. Fls. in panicled spikes. Fr. 1—1·5″ with wings less than ·5″ wide with ascending striations.

Fls. *May -July*. Fr. *March April*. Evergreen.

Along streams in nalas in all divisions.

Hybrids between tomentosa and arjuna are found. One of these found near Wamanpalli (Dhaba Forest) called Arjun-Sadora, *Mar.* or Pandrai-En had bark and fruit of Arjuna with leaves of tomentosa.

Terminalia Chebula, *Retz.* Hara, *H.;* Hirda, *Mar.;* Myrabolan (the fruit, *Eng.*); Karka, *Tel.*

A small or mod. sized tree with rounded crown. Bark grey flaking Blaze hard deep grey brown, then red, inside yellowish *L.* usually sub-opposite ovate or elliptic or ovate-lanceolate 4 by 2 25″ to 7·5 by 4 , young beautifully silvery silky, old, nearly glabrous. Petiole ·5—1″. Fls small whitish in spikes from the upper axils and in small terminal panicles Fruit an ellipsoid or obovoid glabrous drupe ·75—1·25″ (often wrongly called *Nuts*), 5 ribbed when dry (the stone being 5-angled).

Fls. *April-May* and to a small extent *July-Aug.* Fr. *Nov.—Feby.* New shoots *April-May.*

In all divisions, but in greatest quantity on the Baihar and Raigarh plateau (Bal.) in open forest and village lands on metamorphic rocks. The best myrabolans are a bright orange colour when dry and the best time for collection is when the fruit is quite ripe. A form occurs in Sironcha with very broadly elliptic or ovate obtuse leaves attaining about 9" by 5" and about 12 prs. sec. n.

Terminalia belerica, *Roxb* Bahara, *H.*; Takha, *Gond.*

A large, usually a straight tree with dark bark and yellow blaze. L. mostly clustered towards the ends of the twigs obovate or broadly elliptic. Petiole 1—2·5". Spikes solitary axillary 4—6" long. Drupe ·75" diameter usually pyriform or roundish, grey tomentose.

Fls. *Feby. May.* Fr. *Jan.—April.* Deciduous *Jan.-Feby.*

In all districts but especially in moist valley forests. The fruits have little commercial value.

Anogeissus latifolia, *Wall.* Dhaura, *H.*; Yerma, *Gond*; Tirman, *Tel.*

An erect mod sized or large tree with whitish bark shed in thin roundish flakes. Blaze first a thin chlorophyl layer, then brown pink, centre (on wood) pale brown.

L. opp. to alt. 2—4" obtuse or rounded at both ends. Fls. in small heads ·3" diam. Fr. small coriaceous 2-winged about as long as broad with a long beak.

Fls. *June—Sept.* Fr. *October—January,* rarely up to the end of March. Deciduous *Feby.—April*

In all districts, very common. Attains its largest size on the sandstone areas of Chanda, where it often reaches 6 ft. girth. It is much in demand for cart axles and agricultural implements. Yields a copious gum.

Anogeissus acuminata, *Wall.* Fars, Parsia, *Gond*; Pasi, *Tel.*

An erect straight beautiful tree when well grown, but usually found small and deformed in this circle. Branches slender

drooping. Bark nearly black, cracked. L. 1·5—2" mostly sub-opp. elliptic acute at both ends, rarely obtuse, densely silky when young, thinly silky when old. Heads of small fls. solitary or several together from leaf scars and axils. Fruit broader than long.

Fls. and new leaves *March-April.* Fr. *April.* Nearly evergreen.

N. and S. Chanda, along or near rivers on alluvium or sandy soil. It is evidently much used, as nearly every tree is felled or pollarded. In Bengal it is used for carts and ploughs.

Combretum decandrum, *Roxb.* Dhobela, *H.;* Piwar bel. *Mar.;* Boddu tiga, mandra tiga, *Tel.;* Jilbuli (applied to several species).

A large, scrambling climber, sometimes covering the highest trees with the conspicuous cream-coloured bracts of the inflorescence, at other times forming dense bushes. Bark brown. L. oblong shortly suddenly acuminate 3—7" shining above glabrous or appressed hairy and with white tufts of hair in the axils of the strong sec. nerves beneath. Tertiary nerves sub-parallel. Fls small in panicled spikes. St. 10. Fruit 1—1·25" oblong or elliptic with 5 wings.

Fls. *Nov.—Feby.* Fr. *April—June.* Evergreen.

Common in all districts, especially near nalas.

Combretum ovalifolium, *Roxb.* Piwar bel. *Mar.;* Yeda tiga, *Tel;* Madhel (Nagpur, f. *Graham*).

Habit of last but more often climbing, the conspicuous bracts are few or absent.

L. elliptic 3—5" turning dark-red before falling. St. 8. Fruit ·75" with 4 wings.

Fls. *Feby.-March* as the old leaves are dropping.

Chiefly along nalas. N. and S. Chanda, common; Bhan., Rai.

Combretum nanum, *Ham.*

An undershrub with woody rootstock, and numerous erect branches 1—2 ft. high, opp. or alt. leaves which are orbicular or

obovate or lanceolate 2—4" and are at first bright red and again turn brilliant red in December and January. Fls. in long racemes, white. Fr. 1—1·5", 4-winged of a pretty pink or red colour.

Fls. and new shoots *March—May*. Fr. *April—August*. Deciduous *January-February*.

Baihar and Raigarh plateau (Bal).

Calycopteris floribunda, *Lamk.* Ukshi, *Mar.*; Kukaranji, *Gond.*; Bandumurudadu, *Gond.*; Tigadaripoda, *Tel.*; Jilbuli, *Vern.* (*Bhan.*)

A large woody sarmentose or climbing shrub attaining 18" girth with rusty villous shoots, opp. ovate or elliptic acuminate leaves 2·5—5" long, very gland-dotted beneath, pubescent, rarely glabrescent. Fls. villous, without petals, in tomentose dense panicles. St. 10. The fls. exhibit a tendancy to zygomorphy, the style being always declinate towards the posterior sepal. Calyx rapidly enlarges after flowering with sepals ·5—1" long surrounding the 5-ribbed fruit.

Fls. *February-April*, Fr. *May*.

N. and S. Chanda, on the sandstones and southwards, Bhan. (in the south of Pertabgarh and Weinganga ranges).

XXX.—MYRTACEÆ

Eugenia Jambolana, *Lam.* Jam, Jamun, *H.*; Naindi, *Gond.*; Nerad, *Tel.*

A large tree. Bark brown to nearly black. Blaze red. L. opp. ell. or ell.-lanceolate 4—6", gland-dotted. Fls. white, ternate in 3-chotomous panicles. Berry 1-seeded ·5—·75".

Fls. *May-June*. Fr. *June-July*. Evergreen. Renews leaves with fls.

Along nalas and in villages in all divisions.

The hill form described in Flora Chota-Nagpur (pp. 351-352) possibly occurs in Bil.

Wood used for well curbs.

Eugenia Heyneana, *Wall.* Kat Jam, *H*, Pan Jambun, *Mar.*

A shrub or small bushy tree 8—20 ft. with narrowly oblong-ell. or lanceolate acuminate leaves 3—5". Berry ·5—·6" oblong crowned by the cup of the hypanthium.

Along rivers only. Somewhat resembling a willow in the leaves.

Bhan.; N. and S. Chanda; Rai.; and probably in all divisions. Fls. *May-June.* Fr. *July-August.*

Barringtonia acutangula, *Gaertn.* Pankumbi, *H.;* Batta *Gond.*; Tivar, Jugli, *Mar.;* Karpa, *Tel.*

A small tree, sometimes attaining 5 ft. girth, but short. Old trees with dark grey furrowed bark, blaze cheesy thick pink. L. obovate or oblanceolate entire or denticulate clustered towards the ends of the branches, 2—5" long (rarely attaining 9" by 4"). Long drooping racemes (attaining 2 ft) of fls. ·3" diam. conspicuous from their bright red stamens. Fruit oblong quadrangular about 1".

Fls *April-May* and also *October—December.* Fr. *September.*

Along nalas and rivers, N. and S. Chanda.

Careya arborea, *Roxb.* Kunab, Kumbi, *H.;* Kumhi, *Chh., Mar.;* Gumur, *Gond.;* Buddadarmi, *Tel.*

A small or m. s. tree with large obovate leaves, 6—15" long, clustered towards the ends of the branchlets, slightly crenate-denticulate with 10—12 prs. sec. n. Fls. large, white and pink, in few fld. spikes with large bracts and bracteoles sessile or sub-sessile. Petals 1·75". Filaments very numerous, long. Fruits large, green, 2·25—3" diam. crowned with persistent calyx.

Fls. *March—May.* Fr. *July.* Deciduous.

Fairly frequent in the damper forests in all districts.

Careya herbacea, *Roxb.* Bhui Kumbi, *Gond.*

An undershrub from a woody rootstock sending up annually dwarf shoots with cuneate-obovate serrulate leaves 6—8" long

which are at first red, and one or two large terminal fls. with purplish petals 1—1·25 long.

Fls. *June-July*. New shoots in *April*

Open grass-lands on the Baihar and Raigarh plateau (Bal).

XXXI.—MELASTOMACEÆ.

Melastoma malabathricum, *L.*

A beautiful bushy shrub attaining 15 ft. with 4 angled strigose branches, 3—7 basal-nerved rough leaves 3—4" long and bright mauve fls. 1 2" diam. in terminal clusters with conspicuous dimorphic stamens.

Fls. *March –May*. Evergreen

Along water-courses, but not general.

Bal. plateau ; Sironcha and Ghot (S. Ch).

Memecylon edule, *Roxb.* (Syn. N umbellatum, *Burm.*) Var. contractum. Ali chetu, Nakrigadem, *Tel.*

A small evergreen tree 1 ft. girth or shrub, somewhat resembling a Jamun. Blaze hard thin, pink coloured Leaves opposite lanceolate to ovate shortly bluntly acuminate leathery 1 5—2 5" long, the underside with minute black dots. Fls. in blue subsessile heads along the branches. Fruit a small black berry ·25" diam. The heads consist of two or three very shortly pedunculate cymes. The nerves of the leaves are very obscure.

Fls. *April-May*, also *December* (? *April—December*).

Along nalas and rivers Gregarious along the Marwapatra nala, Singpur Range (Rai.); Dina River, near Ambela, in S Ch (*Donald*) Sironcha (S. Ch.) frequent

[This is by no means typical M. edule, *Roxb.* nor M. umbellatum, *Burm.*, which is reduced to 'edule' in F. B I. Mr. Craib, in charge of the Indian sections at Kew, and myself, have tried in vain to bring it under any of A. Cogniaux's species or varieties, as the lateral and transverse nerves are so indistinct that the plant becomes removed altogether from the 'edule' section of Cogniaux. It comes, however, very close to Clarke's' variety ' ramiflora.' The ultimate branchlets are 4-angled or sub-terete. Petiole ·2—·25."

Calyx at the time of flowering campanulate afterwards saucer-shaped, irregularly shallowly 6—8 lobed.]

XXXII.—LATHRACEÆ.

Lagerstrœmia parviflora, *Roxb* Lendia, *H.*; Sena, *M.*; Chinangi, *Tel.*

A small or large tree with grey or reddish bark stripping off in narrow longitudinal flakes when old. Blaze light brown. L. opp. elliptic or ovate-lanceolate acute or acuminate, foliage when old with a grey or glaucous appearance. Delicate white fls. in trichotomous panicles on the new shoots Capsule 1—1·5" long 3—4-valved.

Fls *April-May.* Fr. *December—January.* Deciduous *February-March.*

Very common in all districts, but only attains large dimensions in valleys. Valued for poles and agricultural implements and a first-rate coppicer. Coppices from the sides of stools.

Lagerstrœmia indica, *L.*

A handsome shrub with white pink or mauve fls. 1·5—2" diam., growing well in the gardens of the C. P.

Lawsonia able, *Lamk.* Mehnde, *H*

The Henna, is a small, often spinescent tree or large shrub somewhat resembling a myrtle with lanceolate or narrow-rhomboid leaves and very fragrant small cream-coloured or white fls., ·25" diam. Capsule small globose irregularly dehiscent with very numerous angular seeds.

Fl. and Fr. chiefly in cold season.

Very common in village hedges and gardens.

Punica Granatum, *L.* Anar, *H.*

The pomegranate is either placed in this family or in the Punicaceæ. It has beautiful scarlet fls. and is often cultivated.

Woodfordia floribunda, *Salisb.* Dhawi, *H.*; Dhawai, *Chh.*; Phulsati, Dhaiti, *Mar.*; Jagi, *Tel.*; Jhilbila, *Vern*, a name applied to a great variety of shrubs.

A bushy shrub, very beautiful in flower, with opposite or ternate simple subsessile lanceolate leaves 2·5—4" long, silvery finely pubescent and gland-dotted beneath. Fls scarlet tubular ·5 -·75" long in fascicled cymes along the branches, somewhat zygomorphous.

Fls. *Jany.—April.* Fr. *April-May.*

Nearly leafless in March and April

In all districts. The minute seeds may be germinated in damp brick rubble.

XXXIII.—SAMYDACEÆ.

Casearia tomentosa, *Roxb.* Kala Karai, Lenga, Lenjo, *Mar.;* Tondri, Mima, *Gond.;* Chilka duddi, Kani misri, *Tel.*

Bark cinerous, rather rough, thick. Blaze hard pink or in old trees crimson with thin bands of brown, then yellowish. A small tree with pubescent twigs, oblong leaves (or the lower ones somewhat ovate or elliptic) from 2 (at the base of the twig) up to 7" long, entire or crenate, pubescent, especially on ribs beneath and usually pellucid dotted. Fls. green ·2" diam. in clusters axillary and from leaf scars. Capsules ·7—1·25 long, soft, green, ellipsoid or oblong 6-angular. Seeds with scarlet aril.

Fls. *March—May.* Fr. *April.-May.* Sub-deciduous *Feby.-March.* Leaves turn red before falling.

Chiefly in the damper valleys (and often confused with Polyalthia cerasioides) Bhan.; N. Ward.; N Ch.; S. Ch.; Bal.; Rai. Bil.; but not very common.

The fruits are often used for killing fish, but this custom does not seem to be prevalent in the C. P. Coppices well.

Casearia graveolens, *Dalz.* (Syn. C. glomerata, *Roxb.* according to Brandis) Safed Karai, Kurdan, *Mar.;* Kuria *Gond.*

Blaze streaked yellowish and white. A small erect tree with rather large glabrous usually elliptic leaves 4—8" long. Fls. small greenish in dense clusters from the (usually) leafless axils. Fruits broadly ellipsoid yellow when ripe ·6—·75" long. Seeds as in last.

Fls. *May—June*, when leafless. Fr. *May—July*. Old leaves turn copper coloured in *Jany.—Feby.*

More common than the last in all districts.

XXXIV.—CACTACEÆ.

There are two species of Opuntia (prickly pear) found in the Circle. These have been named from a perusal of Mr. Burkill's "Determination of the prickly pears now wild in India," published in the Records of the Botanical Survey of India.

Opuntia elatior, *Mill* Nagphana, *H.*

A succulent plant with jointed flattened stems, leaves minute on the young shoots, curved subulate deciduous, clusters of long, straight slender tawny or purplish black spines at each axil, large yellow or red fls.

Very common about Nagpur and frequent in all districts.

Fl. and Fr. in hot and rainy seasons.

The fruit is edible, but is covered with short bristles on the cushions.

A young Opuntia seed on germination develops two normal cotyledons from between which at once arise a clavate fleshy stem without intermediate forms. An unripe fruit will behave like a cutting.

Opuntia monacantha, *Haw.*

Similar to the last but somewhat different in habit and with only a single long permanent spine on each cushion.

Khairagarh State, *f. Burkill;* Bhandara, *f. Burkill;* Bilaspur.

XXXV. ARALIACEÆ.

Heptapleurum venulosum, *Seem.*

A large climbing or epiphytic shrub attaining 3 ft. girth with digitately 5—7-foliolate leaves and small yellow fls. in panicled umbels. Lfls. 2—6" long. Petioles 3—6." Petiolules 1—2."

Fls. *May—June.*

Climbing chiefly on rocks in damp localities. Highest parts of the Lormi forests (Amarkantak hills, Bil.); Laughar, Baihar plateau (Bal.).

XXXVI.—UMBELLIFERÆ.

Peucedanum Dhana, *Ham.* Bandraj, *Bhumia.*

A perennial herb dying down annually to the thick fleshy root with long-petioled glaucous 3—5-foliolate radical leaves with lanceolate or linear-lanceolate leaflets 1—3·5″ long, and branched nearly naked stems 1—2 ft. high with compound umbels of small yellowish flowers and dorsally compressed fruits.

Fls. Fr. *April—June*

Baihar and Raigarh plateau (Bal.), Lormi forests, elev. 2,000 ft. (B.l.) The root is used as a tonic by the Bhumias.

Carum stictocarpum, *C. B. Clarke.* Var. hebecarpa.

A herb 1·5—2 ft. high, with many slender leafy branches and 1—2 pinnately 3-foliolate leaves with the leaflets cut into linear-lanceolate segments. Fls. minute, white, in many small compound umbels. Frt. small didymous.

Fl. Fr. *Jany.—March.*

Sonawani and Paraswara forests (Bal.); Lormi forests (Bil.). The seeds are used in curries, etc.

Pycnocycla glauca, *Lindl.*, is an interesting umbellifer with rush-like stems and flowers in heads resembling those of a Scabious or Composite. It occurs in the grass lands of the Balaghat plateau.

XXXVII.—CORNACEÆ

Alangium Lamarckii, *Thwaites.* Akolo, Ankol, *H.; Mar.;* Pru, *Gond;* Udugu Chetu, *Tel.*

A small bushy tree attaining 25 or 30 ft. girth, usually thorny. Bark light-coloured, somewhat flaking. Blaze cream-coloured, with oblong lanceolate or elliptic leaves 3—6″ long, with somewhat unequal sub-3-nerved base, upper surface with pubescent nerves, beneath sparsely hairy and with gland-pits or tufts of hairs in the

strong nerve axils. Fls. white mod.-sized fascicled, with 5—10 very narrow petals ·5 - ·7" long and 20—30 stamens. Frt. a black ellipsoid drupe ·5—·7" long crowned by the calyx-tube.

Fls. *March - May.* Fr. *June — July.*

More or less leafless at the time of flowering. Chiefly near nalas, but local, all divisions. Bhan. (Dongargaon, common); N. Ch. (common along rivers at Chimur, etc.); S. Ch. (common in Sironcha range); Rai. (common in Sihawa forests); Bal. (Sonawani range, Khairgondi nala); Bil. (Khatra).

XXXVIII.—RUBIACEÆ.

Adina cordifolia, *Hook, f.* Haldu, *H.;* Kalmi, *Kamar;* Uaspu mundi, *Gond.;* Paspu Kadami, *Tel.*

A large tree with light-coloured bark patchy from exfoliation. Blaze pink with an inner white border. Wood yellowish. L. large broadly ovate or orbicular cordate 4—8" long and broad. Stipules sub-orbicular enclosing the terminal bud. Heads ·75—1" diameter, long peduncled, usually in axillary rows of three.

Fls. *June.—July.* Fr. *Feby —May.* Deciduous *Feb.—May.*

In all districts, but not usually common. Attains large size on the sandy soils of N. and S. Chanda, especially in hills. Both timber and poles are used in building, and planks used for doors.

Mitragyna parvifolia, *Korth* (Syn. Stephegyne parvifolia, *Korth*), Karam, Kaini, kalmi, *H.;* Chimia Mundi, *Gond.;* Karmi, *Tel.*

A large tree with bark and blaze somewhat similar to the last. Leaves broadly elliptic 4—6" by 3—4" Stipules broadly oblong enclosing the terminal bud. Heads of fls. 1" diam., 1—3 together, each with two pale-coloured leaves (bracts) near the top of the peduncle.

Fls. *May—June.* Fr. following *March* and *April,* but ripe seed also collected in *November* (in Chota Nagpur). Deciduous *May.*

In all districts. Common on cotton soil and loam, especially near rivers and often forming second growth forest. It is considered inferior to Haldu.

Anthocephalus Cadamba, *Miq.* Kadam, *H.*

A large tree with horizontally spreading branches, smooth brown bark, thick yellow-brown blaze, white on the wood. L. large elliptic-oblong or ovate 5—10" long, with usually sub-cordate base and 8—15 pairs strong sec. nerves. Stipules enclosing the terminal bud, narrow lanceolate ·5—·6" long. The ripe fruits are coalescent into a large yellow pseudocarp which is eaten.

Fls. *May – July.* Fr. *Aug.—Oct.*

In the villages of Raipur (esp. Dhamtari) and Bilaspur districts, but not seen wild in the Circle ; Balaghat Station.

Hymenodictyon excelsum, *Wall.* Bhorsal, Bhawarmal, *Mar.*, Bhawar, *Kamar* ; Potur, *Gond.* ; Marich, *Chh.* ; Dudipa, *Tel.*

A large or m.s. tree with dark-grey thick rugged bark. Blaze soft pale pink, streaked white, or nearly white streaked, brownish red or yellow. L. towards the ends of the branches ovate to very broadly elliptic 4—10" by 3—6", softly pubescent. Stipules deciduous. Petiole 1—4". Fls. greenish ·25", crowded in dense sub-erect or drooping tomentose panicles 3—6" long, which are subtended by a pair of spreading long-petioled foliaceous bracts.

Fls. *August.*

It is leafless from November or December to May, when it may be easily recognized by its large, drooping pyramidal persistent panicles of small reflexed capsules and the dry persistent foliaceous bracts. Not very common. Chiefly in valleys on sandy soils. N. Ward., Bh. ; N. Ch. ; S. Ch. ; Rai. ; Khairagarh.

Wendlandia exserta, *DC.* Til, *Mar.* ; Mogra, Tilai, *Gondi.*

A hoary pubescent or tomentose small tree with ovate-lanceolate acuminate leaves 4—8" long, persistent recurved stipules and panicles of very fragrant small white flowers.

Fls. *Feby.—April.* Fr. *April—May.* Evergreen.

Chiefly on broken ground and in second growth forest. Not common, but locally abundant.

Appears to require a nearly clean seed-bed in order to germinate. Baihar range (Bal.), Dhamtari, Singpur and Sihawa ranges (Rai.); Elchil (S. Ch. .

A specimen sent by Mr. Rogers from Chikalda (Berar) had leaves merely acute, not acuminate.

Webera corymbosa, *Willd.*

A large shrub with glossy mostly oblanceolate-oblong leaves, somewhat similar to those of a Gardenia or of the Cherry Laurel but smaller, 3 -7" long, suddenly contracted to a short acute tip. Petiole 3—·5". Fls. ·4—·6' diameter white in 3-chotomous corymbs, salver-shaped, fragrant, with the sessile anthers exserted, on the throat nearly as long as the fusiform stigma. Berry black ·25 diameter.

Fls. *Nov.—Dec.* Fr. *Dec.—Jany.* Evergreen. South Chanda, Dhaba and Sironcha, along sandy nalas.

Gardenia lucida, *Roxb* Dikamali, *H.*; Karenga, *Tel.*

A large handsome bushy shrub with elliptic oblong leaves 4—8" long, acute both ends, with 20—35 prs sec. n. Fls. large, white fragrant, calyx lobes linear-subulate ·2—5", corolla tube 1·5—2·5". Fr. ovoid with thin shell.

Fls. *April—July.* Fr. *April—June* (of next year). Evergreen.

Chiefly along sandy nalas in all districts, while the next species usually occupies the higher or more clayey soils. Very abundant on lateritic soils about Mahasamund (Raipur).

The gum is used especially for an antiseptic for wounds. For sowing it is preferable to separate the numerous seeds, though in the forest the seeds of a whole fruit (which has fallen and rotted) will often germinate together.

The seedlings do best in partial shade.

Var. gummiferoides, *Haines.*

A small deciduous tree with white trunk as in gummifera, not branched down as low as in lucida, leaves with attenuate base sub-sessile, acute, sec. n. 14—18 prs., calyx-lobes ·1—·2" linear

subulate, the corolla-tube is less hairy than is usually the case with gummifera.

Balod range, Raipur ; on high ground. Fls. *February.*

(This may be a hybrid between lucida and gummifera, but the two species show intermediate forms in the C P., and Brandis appears to have confused the fruit of the two species. In the field this more resembles '*gummifera*,' in the herbarium it inclines to '*lucida*').

Gardenia gummifera, *L.* Dikamali, *H.*: Kurmuri, Karmari, *Mar.*; Kulmuri, *Maria*: Kuru, Lahan Kudu, *Gond.*; Chita mota, *Tel.*

A large handsome shrub with white bark, sub-sessile, shining, oblong to obovate leaves 1·5 –3" long, often with narrow cordate base and 12—16 prs. sec. n., usually obtuse. Fls. large white fragrant, sub-sessile calyx lobes ·1 —·2" triangular acute or rarely acuminate. Corolla-tube 1·5—2 5" long and lobes 1—1 5".

Fr ovoid or ellipsoid 1—1·5" with fleshy mesocarp.

Fls. *Feby.—May*, especially when the bushes are bare of leaves, but sporadically at other times Fr. *June—July.* Deciduous.

Like the last it yields a clear yellow resin from wounds in the bark and at certain seasons a clear drop of gum (resin) completely, covers the leaf buds. The fruit is eaten.

Chiefly on clayey loams In all districts, but somewhat local. Abundant and well grown on schists along Mohgaon-Baihar road.

Gardenia latifolia, *Aiton.* Papra, papar, *H.*; Paria, Donga, Kuru, Gogal, *Gond.*; Ghogar, *Mar.*; Gegar, *Tel.*

A small bushy tree with smooth pale bark. Large opp. or 3-nate broadly elliptic or orbicular sub-sessile leaves 4—10" long with about 12 prs. sec. nerves. Fls. large white 3—4" diam. Calyx teeth 5—9 unequal lanceolate. Cor. tube 2 –3". Fr. 1 5—2" diam.

Fls. chiefly in *April* when leafless and with new leaves in *May*.

Fr ripens about eight months after flowering.

Sometimes epiphytic Common in all divisions.

Gardenia turgida, *Roxb.* Khurur, *H.*; Phetra, Pendra Safed phetra *Mar.*; Yerra bikki, *Gond.*; Telelka, *Tel.*

A straight erect small tree with narrow crown, white or pale grey bark and r'g'd branches armed with straight thorns. Blaze with a chlorophyll layer, then white with yellow specks, cream-coloured on wood. L. 1—4" elliptic or usually obovate, sometimes orbicular and densely tomentose (var. montana). Fls. white Males ·5—1." Females larger, sol tary. Fruit large globose 1 5—2" diam.

Fls. *April—May*, mostly, when leafless, but also at other times.

Fr takes about one year to ripen.

Randia uliginosa, *DC.* Pindaru, *H.*; Kumbikum, Telka, Katil, *Gond.*; Dudhkela, Kala phetra, Tel pendra Karphendra, *Mar.*; Kuvenka, *Tel.*

A shrub or small tree with thick black branches, sometimes thorny. Handsome when in flower with large elliptic or obovate fascicled leaves 2—8 long and solitary pure white flowers. The fls. are dimorphic, large and sessile or smaller and peduncled, but some fls 1·5' diam. have a penduncle over 1". Berry large green or yellowish ellipsoid 2—2 5".

Fls. *May—July.* Fr. *Dec—April.* Deciduous *Feby.—April.*

In Chota Nagpur the unripe fruit is eaten and makes a good vegetable when cooked, but only a few of the Marias appear to know this in the C P

Chiefly, and very common, on cotton soil in all divisions.

Randia dumetorum, *Lamk.* Mainphal, *H.*; Ger, Mainhar, *Mar.*; Manhar, *Gond*; Mendhir, *Chh.*

A small bushy tree or very large shrub with smoothish but cracked grey bark and thick soft pink or reddish blaze. Branches usually armed with straight axillary thorns. L. mostly clustered on short branchlets 2—4" obovate obtuse with base narrowed into a very short petiole somewhat pubescent. Fls. white turning yellow ·5—1·25" diam. with short campanulate tubes ·25—·4" long. Fr. yellow when ripe globose or ovoid ·75—1·25" diam. crowned by the calyx tube. Fls. *April—June* with new leaves. Fr. *Aug.—Jany.* More or less deciduous *March—April.*

Bhandara, common ; N. W. (Magardokra forest) ; N. Ch. ; Baihar and Raigarh ranges (Bal). ; B'l. ; Sihoa (Rai.) common.

The fruit is used for intoxicating fish. It has a most agreeable smell, but produces an uncomfortable burning in the throat. Mr. Innes (Report on Famine Foods) states that when *unripe* it is boiled and eaten but the ripe fruit is rather poisonous.

Opinion of its edibility differs among the Gonds.

Canthium parviflorum, *Lamk.* Katbor, *Mar.* ; Balasu, *Tel.* ; Bersia, *H.*

A large shrub or small tree, with grey bark longitudinally flaking when old, with rigid branches conspicuously armed with opposite decussate pairs of strong thorns above the axils. L. ·5—3″ long elliptic, ovate, obovate or orbicular, base usually narrowed into a short slender petiole, glabrous except round the grandular pits in the nerve axils of some of the leaves. Sec. nerves 3—5 prs. raised translucent. Fls. small yellowish 4-merous in short dense cymes. Frt yellow sub-globose 5—·75″ diameter on peduncles about ·5″ long, with an apical areole surrounded by the 4-short linear sepals. Pyrenes 2.

Fls. *May—July.* Fr. *Sept.—Nov.* Deciduous *April—June.*

Chiefly on cotton soils in open ground. N. Wardha (common Bori) ; N. Chanda (common in Minjhari block, etc.) ; S. Chanda, common ; Khondra (Bil.).

The natives often confuse it with Randia dumetorum. (There is frequently a pair or fascicle of leaves below the thorns, due to the development of an axillary bud the subtending leaf of which and of the thorn has fallen.)

Canthium didymum, *Roxb.* Nuna akalu, *Tel.*

A shrub or small tree with spreading or drooping compound branchlets, bifarious ovate or lanceolate-ovate acuminate leaves 3·5 —6″ by 1·5—3·25″ which are dark-green and shining above and pale beneath with 4—6 prs. sec. n., of which the first is close to the base. Nerves usually with gland axils. Petiole ·3″. Fls. long-pedicelled small greenish 5-merous, ·25″ diam in very dense short

peduncled corymbose cymes. Fr. black globose ·3″ diam. with two pyrenes.

Fls. *Feb.-March.* Fr. *April-May.* Evergreen

Along sandy nalas Sironcha range (S. Chanda) only.

Vangueria spinosa, *Roxb.* Petu, *Gond.*; Mainphal (from confusion with Randia dumetorum), *H.*

A large shrub or small tree, often armed with long, straight thorns, with ovate ell. or oblong acute or suddenly acuminate leaves 3—4″, rarely few 6″ by 3″ (only 1·5 2·5″ at time of flowering), often fascicled and more or less pubescent. Small green subglobose fls. ·125″ diam. in dense axillary cymes. Calyx lobes 5 linear spreading, corolla lobes triangular cuspidate, throat villous with white jointed hairs. Ovary 5-celled. Stigma large globose. Fruits 1—1·5″ diam. globose green marked with a large apical areola, with 1—5 woody pyrenes.

Fls. *April-May.* Fr. *Aug.-Oct.* Deciduous *March-April.*

Chiefly in the eastern divisions. Raipur (Laon and Singpur-Khallari ranges, on laterite); Pantora range, Bilaspur; S. Chanda, rare *f. Donald.*

The fruit is eaten.

[Most of the C. P. specimens belong to variety *mollis* with very pubescent leaves, base of leaves rounded then somewhat decurrent on the petiole. A specimen from Pondi, Chanda, much less pubescent and with cuneate leaf base appears to be another variety.]

Pavetta indica, *L.* Papidi, *Tel.*

A large shrub with elliptic or obovate softly pubescent leaves 3—8″ long with petiole ·5—1″ long. Large 3-chotomous corymbose pubescent panicles of slender white fls. ·5—·75″ long with very slender style exserted ·75—1″ beyond the corolla throat. Fruit globose black ·3″ diam. with two pyrenes.

Fls. *June—Aug.*, Fr. *Oct.—Dec.*, and shrivelled berries may be found much later. In the damper forests and northern slopes

of hills in all divisions. Common in Sihoa (Raipur), Bilaspur and South Chanda.

Ixora parviflora, *Vahl* Lokhandi, *H.*, *Mar.*; Disti, *Gond.*; Gorwi, Koripal, *Tel.*

Usually a small tree with smooth very coriaceous glabrous oblong or elliptic sub-sessile leaves 3—6″ by 1·5—2·5″ with rounded or cordate base and compact panicles 2—6 long of smallish white sessile scented fls. ·3 long. Petiole sometimes ·3″ long. Frt. ·25—·3″ diam. depressed globose black and shining.

Fls. *March May.* Fr. *May-June.* Evergreen.

Along nalas in all divisions. Also on cotton soil and in the damper forests but rarer.

In Sironcha it attains 20″ girth, with pale grey, rarely smooth bark and flesh-coloured blaze.

Morinda tinctoria, *Roxb.* Ahl, *H.*; Tzogar, Chogar, or Togar mogi, *Tel.*

A small tree 15—25 ft. high and up to 3 ft. girth, bark brown or grey, corky. Blaze grey-brown. Twigs often square. Leaves large ovate or obovate or broadly elliptic or upper oblanceolate Fls. white ·75—1″ diam, with tube ·5—·7″ long in solitary or 2-nate leaf-opposed or terminal stalked heads. Fruit a large pseudocarp with prominent drupels.

Fls. *May* Fr. *Jan.-Feb.*

Kota (Bil.)

Var. TOMENTOSA.

Branchlets pubescent or tomentose L. elliptic tomentose or pubescent up to 10″ (only 3—5″ at the time of flowering).

Stipules caudate. Pseudocarp smooth.

Frequent.

N. W.; N. Ch. (abundant near Karsinghi); S. Ch.

Hamiltonia suaveolens, *Roxb.*

A shrub, fœtid when bruised, sometimes 10 ft. high with erect branches, stiff leaves 4—9″ by 1·5—3″ and large terminal 3-chotomous panicles of small sweet-scented 4—5 merous white or lilac

fragrant fls. ·5—·6" long which are clustered on the branches of the panicle. Frt. a small 5-valved capsule.

Fls. *Aug.—Jan.*

In rocky places, chiefly on the cool sides of hills and valleys. On quartzite ridges, Bawanthari range (Bhandara); Sonawani range (Bal.). On trap in H.ngni range (Nag. Wardha).

Rubia cordifolia, *L.* Manjeti, *Bhumia.*

A herb scrambling by means of its scabrid stems and whorled ovate-cordate long petioled leaves. Fls. minute deep yellow in panicled cymes. Corolla rotate. Ovary 2 celled. Frt. ·12—·17" diam. fleshy, didymous.

Fls. r. s.

Lormi forests (Bil.) ; elev. 2,500 ft.

It yields a dye (Madder). It is curious that the Bhumias give the same name to the plant as do the Nepalese (*viz.*, Manjit).

(To be continued.)

" MOYA " GRASS FOR PAPER-PULP.

BY W. RAITT, F C.S , DEHRA DUN.

Mr. A. E. Lowrie (late Deputy Conservator, C. P.) has recently drawn the attention of the Research Institute to this grass. It has been identified by Mr. Hole as *Pinesetum alopecures*, and the Cellulose Expert finds it to yield 39 per cent. of pulp which is easily bleachable and of a quality strongly resembling that obtained from baib grass.

Mr. Lowrie reports it as growing, massed and gregarious, over large areas in the hills of the Central Provinces, and under conditions which appear to indicate cheap collecting and manufacturing costs He specially calls attention to its presence in the neighbourhood of the Pench Valley coalfield, where also lime, permanent water and railway facilities exist, and he estimates that here from 15,000 to 20,000 tons of it could be collected annually to a manufacturing site at a cost not exceeding Rs. 15 per ton at a suitable factory site This combination of raw material and the chief manufacturing requirements would seem to mark this grass as well worth extended enquiry by those interested in this industry.

DEPARTMENTAL FIRING IN CHIR (*PINUS LONGIFOLIA*) FORESTS IN THE PUNJAB, RAWALPINDI DIVISION.

In the December number of the *Indian Forester* I wrote an account of the result of the Rawalpindi preliminary experiments and investigations on the subject of departmental firing in Chir forests. The experiments showed that forests could be burnt on a small scale without doing appreciable harm to the Chir.

In this article I briefly mentioned the risk that the forests run of being burnt, the way in which they have been repeatedly fired, and the inefficiency of all available methods in preventing and combating fires. The Chir is remarkably resistant to fire and possesses a remarkable power of recovery. It owes this to its thick bark which effectually protects its cambium. Slow fires do little harm to it, but fierce fires ruin whole woods. Most of the fires are ground fires which vary in intensity according to the nature of the soil covering. Fire-protection helps the accumulation of a mass of combustible rubbish in the soil covering, and the longer a forest has been protected the more exposed it becomes to accidental fires, and the greater the damage suffered should it be burnt. This is illustrated in the accompanying photographs (Plates 7 and 8).

The chief problem then was to get rid of this soil covering, as it is obvious that if this combustible layer could be got rid of the safety of the forests would be assured. This was accomplished

Departmental firing in Chir Forests in the Rawalpindi Division, Punjab.

Fig 1 Kamra R. F. (6), Kahuta Range. Burnt 1890, '95, '99, 1911.

Fig. 2 Baga R. F. (19), Kahuta Range. Departmental firing in progress: flames one to two feet high.

[*Note.* Photo. No. 1 shows the damage done in a forest fire-protected for many years. It also shows the remarkable way in which Chir persists, though all but a few branches have been killed].

Departmental firing in Chir Forests in the Rawalpindi Division, Punjab.

Fig. 3 Baga R. F. (19) Kahuta Range. Remains of polewood, burnt over 1890, '95, 1909.

Fig. 4. Sang (41).

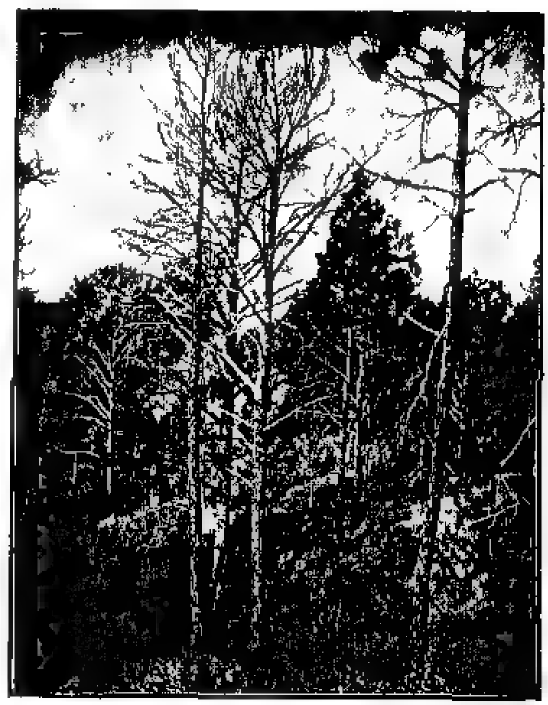

Fig. 5 Sang (41).

Burnt in 1890, '94, '96, 1911.

[*Note* These Photos. show the damage done in a Forest fire-protected for many years. They also show the remarkable way in which Chir still persists, though all but a few branches, have been killed.]

by means of slow fires, which were put through the forests in the cold weather and have cleared away the dangerous mass of *humus* and rubbish The forests have not been damaged by this process and no inflammable layer remains in the 2,500 acres experimented with. The remainder of this article consists of an extract from a paper discussed by the Punjab Forest Conference in March, and deals with the experiments on a large scale made in Rawalpindi last cold weather.

The Forest Conference passed the following resolution :— "Resolved, that the principle of departmental firing in Chir forests, coupled with a regular method of regeneration, be accepted for the Rawalpindi Division ; and that experiments regarding the feasibility of introducing a similar scheme into the Kangra Division be carried out."

EXPERIMENTS ON A LARGE SCALE MADE IN THE COLD WEATHER OF 1913-14.

As winter approached, experiments on a large scale were made. They are described individually in Appendix I, which should be read carefully; while a general description of a forest being fired is given in a later paragraph.

Experience soon proved that October was much too early to start experiments. November also appeared to be rather dangerous, but from the beginning of December onwards fires were easily controlled. Winter brought a fair amount of rain with intervals of a fortnight of fine weather, enough to dry the soil covering sufficiently. The crops burnt consisted for the most part of closely grown IV class poles 2' 6" and under in girth, with scattered larger or mature trees and groups of saplings down to about 12 feet in height. Young regeneration below 5 feet in height rarely occurred, and has not been taken into consideration at all. The soil covering varied but generally consisted of a thick layer of needles with sometimes a fair amount of grass. In cases 'sanatha' and 'garanda' undergrowth reached a height of 6 feet or over.

In nearly every case the forest had not been burnt over for a long period and was in an extremely combustible state. In fact,

the forests experimented on were those in which the very gravest results from accidental fires were to be feared.

The locality of the experiments varied from the low-lying hot slopes on the borders of the Jhelam to the topmost limit of the chir zone. Nearly every condition of slope and aspect were encountered and much broken country were traversed. The experiments were at first started on easy slopes, but as experience was gained they were extended to steeper hillsides, often much broken up by ridges and nullahs.

Co-operation of villagers.

Throughout the division villagers gave free and ready help as they expect a good grass crop after burning. They soon learnt the methods of controlling the fire and take a vivid personal interest in the operations. There is every promise of their now refraining from attempting to burn the forest in the hot weather for the sake of grass.

Control.

The first experiments were made in my presence, Rangers, picked Deputy Rangers and Foresters being put in charge of small sections and firing lines. The forest chosen was Kalabasand which had not been burnt for many years and presented a variety of slopes, nullahs and ridges, excellent for giving experience in rather complicated cases. Later on the experiments were conducted by the Rangers, and subsequently by Deputy Rangers and Foresters acting entirely on their own responsibility, the locality of the experiments being determined by me.* I inspected nearly all the areas burnt in company with the men who had been in charge, and there are now in the division 4 Rangers, 2 Deputy Rangers, 4 Foresters and 2 Head Guards who are each fully capable of supervising the burning of a daily average of 50 acres of forest. The number of villagers necessary varies according to the steepness of the ground, more being needed on steep slopes. *Generally speaking, the more* assistance available, the better the control; but once the fire has been properly started, the number of men needed is surprisingly small.

In Kaloian Chakla (24) 1 Ranger, 1 Forester, 3 Guards and 17 coolies burn 135 acres in a day giving an average of 8 acres per

cooly. I do not recommend such small numbers being employed, as it is far better to be on the safe side, especially when labour can be had free. At night 2 Guards and half a dozen coolies are ample, but it is necessary to confine the fire within definite limits before leaving it for the night. Night chaukidars are always paid at the rate of annas 4 per night.

Description of burning in progress

Suppose a typical forest has been selected for burning. It consists of a dense mass of poles of various sizes averaging about 2½ feet in girth at breast-height, with many dominated and suppressed poles, that are in most urgent need of being thinned. Scattered through the crop are patches of larger poles or 2nd class trees and occasional over-mature mother trees. In places there are groups of saplings some 15 to 20 feet high, and in open glades are scattered young seedlings and small chir regeneration.

The forest probably spreads from a median ridge over a large number of subsidiary spurs and nullahs. In the denser parts there is a thick layer of dry fallen chir needles, and in the more open portions grass, in the clumps of which old dead blades persist, intermingled with fallen chir needles. In places 'sanatha,' 'garanda' and other bushes reach a height of 4 to 8 feet.

The firing line

A part of this forest varying from 30 to 150 acres, and fairly well isolated from the rest by conspicuous nullahs, ridges, or even a village path, is first taken in hand. At the top a line is cleared in the soil covering and a fire is started along its whole length, and allowed to travel downhill only. The fire moves in a fairly regular line, but recedes very slowly. In the course of an hour a few feet only may have been traversed. Ridges and nullahs tend to make the line irregular, and along each ridge subsidiary fire lines are started and lengthened as the main fire-line advances, *the object being to keep the firing line moving regularly and evenly downhill.* The flames are small, about 1 foot to 2 feet in length, and are in marked contrast to those arising from a fire that burns uphill. The fire is bound to burn uphill occasionally over a few feet owing to irregularities in the ground, but at this, the winter season, is easily controlled.

On steep places burning cones roll downhill and set fire to the forest below the firing line. Fires started in this way do damage which is not at first evident, and signs are first noticed about a *week afterwards when the needles of the trees turn brown*. This does not necessarily mean that the trees are dead. On very steep slopes it may be necessary to station men below the firing line to put out these fires immediately they occur. This can be done fairly easily. As a rule, it is only necessary in a very small part of the area. If sufficient labour is available other fire lines are also made once the top line is burning safely. These always run along ridges or contours, and the fire is always made to progress downhill. Should the experiments not be finished before night, lines are cleared along nullahs, ridges or contours and burning is confined to as isolated an area as possible On easy ground the fire is allowed to go on burning down hill, a couple of guards and 4 to 6 coolies being left in charge to prevent other portions of the forest catching fire.

Results

(*a*) *On tree crop* -The upper side of the bases of the chir trees are blackened The outer bark is scorched to a depth of $\frac{1}{8}$th of an inch and the underlying bark is unaffected. In some cases the scorching is more severe, but never sufficient to harm sound trees above the sapling stage. Once a tree has reached about 15 inches in girth, it is quite safe. Even smaller trees scarcely ever suffer. The effect on trees growing on one stool is apt to be more pronounced. As already stated, the needles of trees on some steep slopes have turned brown, and their outer bark has been scorched, but close examination has revealed no permanent injury. The cambium zone has not been affected.

Trees with bases already damaged are coated with resin which often burns for several minutes and causes the wounds to extend. Young regeneration below 8 feet in girth is very occasionally killed, but is often severely scorched. The cambium zone of these small trees often turns brown on the upper side of the stem while the *saplings continue to live with what must be seriously impaired* strength. Seedlings of 1 to 2 feet in height are usually killed, but sometimes escape.

(*b*) *On undergrowth.*—Undergrowth consisting of 'sanatha,' 'garanda' and myrsine is generally killed. The dead bushes do not appear to be so inflammable as at first anticipated judging from our experience in Bagla 40 (Appendix II) and in Palah 70 (Appendix III).

(*c*) *On the soil covering.*—Grass is always burnt, but its roots are unaffected. Needles are completely burnt only in rare cases. Charred remains of the layer next soil have been noticed in every forest and form a valuable *humus*, preventing the soil from denudation. This thin layer does not form a danger from fire, while the ashes should make a good manure. A reference to Appendix II, experiment (*2*), will show that the danger from a subsequent fire is not great.

General conclusion

The experiments show most conclusively that, except in regeneration areas, woods can be fired on a large scale without doing appreciable damage to the chir.

The dry grass, dead chir needles, etc., forming the soil covering, can be burnt without difficulty, and the forests thus cleared of a mass of combustible rubbish that is the cause both of the occurrence and the intensity of hot weather fires.

(2) The ordinary divisional staff is capable of controlling extensive operations when assisted by the local inhabitants.

(3) The time of year best suited for burning is the winter from December to the end of February, as at this season fires are not fierce and can be easily controlled. Villagers are then willing to give free labour, and sufficient time has been given them for harvesting the grass.

Sylvicultural system

Side issues.—The method of working the forests has a very important bearing on the organisation of departmental firing operations. It is most undesirable to have small patches of regeneration scattered all over the forests as is contemplated in the Selection System. Given successful protection of the block under regeneration the Uniform System is the most suitable; and in view of the facts that the chir is wind-firm, a prolific seed-bearer, and light-demander, the

introduction of the Uniform System is desirable on other grounds. One word of warning is necessary, however, and that is, that regeneration areas must not be confined to one locality, as they are certain to be burnt sooner or later if sufficient mature woods are not available for grazing. As short a regeneration period as possible is desirable, but my observations tend to show that a chir tree takes at least 25 years to reach a size at which it can resist fire. A reference to an experimental sowing has already been made. Further experiments are necessary, as in the event of regeneration areas being burnt sowings will have to be done artificially.

Past policy.

For many years past the punishment for incendiary fires has been closure to all rights, the object has been to punish the villagers and to deprive them of the advantages of improved grass and grazing Lately, most extensive closures have been enforced, and have had a considerable moral effect on the villagers. In closed forests, however, there is a most abundant growth of grass which in the hot weather will be most inflammable. I think that Government should be asked to enforce communal responsibility in return for increased grazing facilities. Moderate cattle-grazing does not appear to harm the chir and might be allowed in all areas departmentally fired.

Resin tapping.

Chir trees approaching maturity are tapped for resin in the Lower Murree Range, and an extension of tapping operations is contemplated in the near future. On each tree vertical grooves are gradually opened extending well into the sap wood and varying in number according to the girth of the tree tapped.

A five acre patch in Sambli 83 was divided into two halves, one of which was fired downhill in the manner before described without other special precaution. The resin which had exuded at the grooves caught fire on 67 out of 75 trees and severely scorched the bark and sap wood close to the grooves. This scorching is perhaps sufficient to interfere with the future flow of resin, though the damage is certainly not sufficient to interfere

with the life of the tree. The question of the interruption of the resin flow can only be determined when the trees are tapped in the coming season.

In the other half grass was cut and needles removed near the base of every tapped tree before firing. Twelve only out of 73 trees were affected, and in at least three cases the reason appeared to be carelessness in not clearing their bases properly. The cost of clearance was Re. 1 4-0 or 4 annas per acre. This cost could be considerably reduced if resin coolies cleared the base of each tree at their last visit when collecting resin.

A similar practice prevails in the long-leaved pine forests of the United States of America, where resin operators clear the bases of tapped trees of grass and needles and set fire to the forests at the beginning of the winter in order to save a fire in the working season.

There would, therefore, appear to be no reason why forests tapped for resin in the Punjab should not be fired departmentally when the bases of tapped trees are first cleared of needles and grass.

RAWALPINDI:
The 30th March 1914.

H. M. GLOVER,
Deputy Conservator of Forests

APPENDIX I.

1. Name of Forest		Ariari Protected Forest 70.
General	...	33 acres, burnt only in part in 1912. Slope moderate.
Soil covering	...	Thick needles, some partly green grass, myrsine in places.
Crop	...	Dense poles from 25 to 50 feet high.
Control	...	At first ample, but after a few hours left to burn out with very limited supervision. Burnt in October.
Results	...	At first no damage and fire line moved fairly regularly downhill. Afterwards burning chir cones

		rolled downhill and started a fire from below. This very badly damaged chir poles over an area of about one acre.
2. Name of Forest	...	Palah Reserved Forest 70.
General	...	10 acres, last burnt 1911, aspect north, slope moderate and not cut up by nullahs.
Soil covering	..	Fairly dense needles, some half-dry grass, many 'garanda' bushes killed in 1911 fire.
Crop	...	Dense poles, 15 to 40 inches in girth.
Control	...	One Ranger, 1 Deputy Ranger, 1 Forester, 6 coolies ommenced November 9th, 10 A.M., finished at 4 P.M.
Results	...	No damage to chir.
3. Name of Forest	...	Kalabasand Reserved Forest 100.
General	...	90 acres, last burnt 1895, slope gentle.
Soil covering	...	Moderately thick needles ; heavily grazed.
Crop	...	Fairly dense poles, 3 to 5 feet in girth and some mature trees.
Control	...	D. F. O., Ranger, several Foresters, and about 40 villagers. Commenced December 5th, 10 A.M., finished 6th, 5 A.M.
Results	...	No damage, except to few saplings under 4 feet in height. Slight damage to trees with injured bases ; needles partly unburnt.

4. Name of Forest	...	Kalabasand Reserved Forest 99.
General	...	250 acres, last burnt 1895. Slope moderate but steep in places and much cut up by nullahs. Top about 1,000 feet above lower edge of forest.
Soil covering	...	Thick needles with short grass, grazing fairly heavy. In places much myrsine and some 'garanda.'
Crop	...	Dense poles, average 2' 6" in girth, also II class and mature trees, groups of saplings in places rarely below 10 feet in height.
Control	...	D. F. O., Ranger, several Foresters, about 40 villagers; at night 2 Guards and 7 coolies. Commenced December 5th, 10 A.M., finished December 8th, 6 P.M. Fire line taken along contours and extended down ridges.
Results	...	No damage, except to saplings under 5 feet in height and slight damage to trees with wounded bases. Needles partly unburnt.
Noteworthy feature	...	Vertical extent of forest and broken country.

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5. Name of Forest	...	Kaloian Chakla Protected Forest 24.
General	..	135 acres burnt in 1896, 1899, part in 1904. Moderate slope broken by nullahs.
Soil covering	...	Thick needles, very little grass, grazing heavy till 1912.

Crop	...	Poles thinned in 1910, average girth 2 feet to 2 feet 6 inches.
Control	...	1 Ranger, 1 Forester, 3 Guards, 17 coolies. Commenced December 17th, 9 A.M., finished December 17th, 6 P.M.
Results	...	At first no damage whatever was observed. Some trees commenced to turn brown one week after firing.

On 21st January 1914 there were the following :—

Brown—

Dominant trees ...	34
Dominated trees ...	46
Suppressed trees ...	49

Half brown—

Dominant trees ...	167
Dominated trees ...	83
Suppressed trees ...	56

Percentage of dominant trees ...	Brown under 0·1 per cent
Do. do. ...	Half brown 0·5 per cent.

Cambium layer of all, except a very few suppressed trees, is green. Trees have been marked to test power of recovery. All except dominant trees will be removed next thinning in any case.

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6. Name of Forest	...	Baga Reserved Forest 19.
General	...	115 acres, last burnt 1908; slope moderate to steep.
Soil covering	...	Very thick needles, some grass, 'sanatha' bushes 6 feet high in lower portion, dead fallen wood from previous fire in 1908.

Crop	...	Very dense poles averaging 2' 9" in girth with suppressed poles down to 1 foot in girth. In great need of thinnings.
Control	...	One Deputy Ranger, 1 Forester, 1 Probationary Ranger, 70 coolies. Commenced and finished on 29th December 1913.
Results	...	On steep slopes fire travelled uphill owing to burning cones rolling down, causing some trees to turn brown, which when seen a month later had commenced to put out new shoots. Otherwise no damage to chir. Chir needles partly unburnt next soil. Fallen wood not all consumed.

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7. Name of Forest	...	Baga Reserved Forest 19.
General	...	Area, 175 acres. Burnt during last week of January. Duration of experiment 3 days. Same conditions as in No. (6), but more coolies present.
Results	...	No damage whatever.

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8. Name of Forest	...	Nandkot Protected Forest 86.
General	...	235 acres, moderate slopes, last burnt 1896.
Soil covering	...	Dense needles still partly damp from previous rain. A fair amount of grass. Moderate grazing.
Crop	...	III and IV class poles, average about 2' 6" girth needing thinning.

Control	...	One Deputy Ranger, 1 Forester, 1 Head Guard, 3 Guards and about 30 coolies :— 15 acres burnt on January 8th. 80 " " " " 9th. 90 " " " " 10th. 50 " " " " 11th
Results	...	Burnt only with difficulty, as soil covering was damp. No damage at all to chir. Lowest layer of needles partly unburnt.

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9. Name of Forest	...	Balaura Reserved Forest 20.
General	..	80 acres, last burnt 1895. Ground slopes steeply on all sides at an angle of 40°.
Soil covering	...	Thick needles. Short grass. No rain had fallen for a fortnight.
Crop	...	*Dense poles from 1' 6" to 4' 6" in* girth. Some older trees.
Control	...	One Ranger, 1 Deputy Ranger, 1 Forester, 8 Forest Guards and 60 villagers. Commenced 17th January and burnt in three sections, one section being burnt daily. Burning cones rolled down the steep slopes and were extinguished to prevent fire burning uphill.
Results	...	No damage whatever to chir. Lower layer of needles partly unburnt. The noteworthy feature of this experiment was the way in which fire was constrained to burn downhill on steep slopes.

10. Name of Forest	...	Beor Khalol Reserved Forest 77.
General	..	105 acres, last burnt 1894 and 1903 Moderately steep to steep.
Soil covering	...	Thick chir needles and a fair amount of grass and 'sanatha' bushes abundant and over 8 feet high. Some 'garanda' bushes.
Crop	...	Dense poles, 18 inches to 4 feet girth, average 2' 9 : 50 to 60 feet high.
Results	...	No damage to chir, except that a very few trees had turned brown where fire burnt uphill. 'Sanatha' partly killed. Lower layer of chir needles partly unburnt. Additional experiments over 635 acres in all were made in the last week of January by one probationary Ranger assisted by 1 Forester and 2 Guards. The conditions and results were practically the same.

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11. Name of Forest	...	*Bhangal Reserved Forest 15.*
General	...	60 acres, partly burnt in 1896. Slope moderate.
Soil covering	..	Fair amount of grass and needles thick in places.
Crop	...	Poles from IV class upwards. One patch of young saplings from 6 to 18 feet high.
Control...	..	One Forester, 1 Guard and 30 coolies. Fire started and finished on 2nd February.

Results ... No damage at all except in patch of saplings. These are partly brown, but will probably not be otherwise damaged. This patch was $\frac{1}{10}$th of an acre and had long grass below the saplings.

12. In Seribari 56 an area of 187 acres was burnt between the 22nd and 25th of January. The conditions and results were similar to those in Nandkot (Experiment 8). No damage was done.

13. In Baga (19) 79 acres were burnt on the 11th February. Conditions were the same as in experiments 6 and 7. No damage was done.

NATURAL REGENERATION OF DEODAR.

Natural regeneration of deodar in the coniferous forests of the Punjab is a subject which, throughout a fairly extensive period, has received considerable attention, but it is only in recent years that the extensive failure to secure adequate regeneration as the result of repeated fellings has compelled Forest Officers to make any serious attempts to arrive at a knowledge of the difficulties which frequently attend deodar natural regeneration and to devise measures to overcome those difficulties.

Over fifteen years ago attention was drawn to the fact that in many instances fellings made under the Selection System were not followed by adequate regeneration of the deodar. It was remarked that the failure to obtain regeneration was not universal. In some cases the results were all that could be desired, in others no regeneration whatever resulted, and in very many instances, indeed, only inadequate results were obtained. Various reasons were suggested to account for this, and perhaps the most generally accepted explanation was that under the Selection System the opening made in the canopy was not sufficiently large to admit all the light which deodar needs for its successful regeneration.

Whole-hearted supporters of this view then commenced to fell by selection in groups in order to secure a larger opening in the canopy for the admission of light, and while pointing triumphantly to the instances where success was attained, ignored the equally if not more numerous instances, where the increase in the amount of light admitted produced no appreciable results in the shape of increased deodar reproduction. The next step was to introduce the Group System in making regeneration fellings in deodar forests, and this has already been done in two instances in the Punjab

It is too soon yet to seriously criticise the results obtained under this system, but it will suffice to say, that so far good results have not yet been obtained everywhere. In some localities deodar reproduction has been all that could be desired, and in other cases the making of large gaps in the canopy which is an essential feature of the Group System has had no good results. In this respect, therefore, the results obtained under the two systems of felling do not differ greatly.

At the Forest Conference held in 1913 at Lahore, Mr. B. O. Coventry, Deputy Conservator of Forests, read a paper on the conditions necessary for obtaining natural regeneration of deodar. He enumerated and discussed the variable factors of environment which could bear on the regeneration, and by a process of elimination he arrived at the conclusion that the only factor to be considered in this respect was the soil. He further expressed the opinion that it was almost certain that the failure of natural regeneration was due to the accumulation of organic matter which interfered with the proper aeration and drainage of the soil. Mr. Coventry then suggested as measures likely to remove or alleviate this unsuitable condition of the soil, the destruction and burning of undergrowth, the hoeing and turning over of the surface soil, heavy grazing, and the removal and burning of the vegetable débris and humus if possible.

To the same Conference Mr. C. G. Trevor, Deputy Conservator of Forests, contributed a note on the natural regeneration of deodar forests in which he pointed out that in most forests where

fellings had not been followed by natural regeneration of deodar the ground was covered by a layer of chips and refuse of former exploitations in varying stages of decomposition. He expressed the opinion that, owing to the presence of this excess of decaying vegetable matter, the soil became sour and was no longer fertile to deodar in its youngest stages.

Again, at the Conference held during 1914, Mr. Trevor contributed another note detailing the measures he had adopted to overcome this unfertility of the upper layers of the soil in regeneration areas, where natural regeneration of deodar has failed. The entire layer of decaying vegetable débris was dug up, raked together into heaps along with the larger refuse from former exploitation and burnt. The ashes were then scattered over the treated area which was subsequently sown with deodar or a mixture of deodar and kail. The results have surpassed all expectations. In areas in which reproduction was entirely absent, and in which fellings had been repeatedly made, the treatment described above has resulted in ample deodar regeneration, and there is no reason to doubt that given a good seed year the artificial sowings might be discarded and nature left to effect the desired regeneration.

The measures adopted by Mr. Trevor differ only in one essential feature from those prescribed in the most recently sanctioned Punjab Working Plan for deodar forests. Mr. Trevor not only disposes of the vegetable débris lying on the surface of the ground, but removes the considerable layer of more or less decomposed vegetable matter, the presence of which he considers is not conducive to deodar regeneration. There is little doubt that this measure is an essential one, and its omission has been the cause of the failure to obtain regeneration even when all other measures adopted by Mr. Trevor had been carried out.

It therefore appears probable that too long a "course" of deodar and its concomitant accumulation of decaying deodar refuse "upsets" a soil, and that either a prolonged rest from deodar must be given the soil in order to permit nature to effect its own remedy by means of aeration and drainage, or that this result may be obtained without delay by removing the excess of vegetable matter

from the soil by means of fire and so restoring it to a condition congenial to deodar regeneration.

Further trial of those measures will be made during the next few years, and if they are found to be generally successful in localities suited to deodar, then the anxiety about the future of the the Punjab deodar forests may be put aside.

R. M.

FOREST OFFICER FOR A NATIVE STATE.

A Native State in Northern India is offering the post of Forest Officer to a retired officer of the Provincial Service or possibly a superior ranger of Dehra education with good credentials provided he be recommended by the President, Forest Research Institute and College.

The latter will be glad to furnish further particulars to likely candidates. The pay offered is likely to be about Rs. 200 rising to Rs 300 and the appointment would probably be on a 5 years' agreement.

EXTRACTS.

SUBSTITUTES FOR TEAK.

We have received a copy of the following letter from Mr. J. Nisbet, formerly Conservator of Forests, Burma, on the above question:—

To EDITOR of the *Timber Trades Journal.*

SIR,—I have read with much interest the article on "Substitutes for Teak" in your issue of February 7th. The high and increasing cost of teak during recent years has naturally resulted in timber merchants trying to find some cheaper substitute. Various kinds of wood from different parts of the world, and chiefly from tropical forests, have, during the last five or six years, been tentatively introduced into the British market with this

object. But instead of being introduced under their correct names, and allowed to assume the proper place and the true market value that their technical qualities and durability may in time show them to be worthy of, trade names have unfortunately been applied to them such as may quite likely mislead probable buyers, seeing that many of these woods have been described as varieties of "teak," although not one of them has either the slighest botanical affinity with the true teak, *Tectona grandis*, belonging to the natural order *Verbenaceæ*, or any resemblance to the structure of its timber as seen microscopically in a thin transverse section.

But technically, and especially so far as ship-building is concerned, or any kind of work in which the timber is brought into contact with steel or iron, there is this further and most important difference—that none of them contain that peculiar essential oil, which so greatly enhances the durability of teak timber and acts as a preservative to steel or iron in place of corroding them like the tannic acid contained in oak timber This invaluable preservative oil, which caused teak to be preferred to oak for ship-building and other uses, is not to be found in any of the substitutes as yet introduced to the British market under such names as "Yang teak," from Siam; "Eng teak," from Burma; "Borneo teak," from Borneo, or "African teak," from Nigeria and the Gold Coast. Thus both botanically and technically teak stands in a class by itself; and as it is the only timber tree of the genus *Tectona*, the use of the word "teak" when applied to other kinds of wood exposes timber merchants using such a term to the suspicion of misrepresentation.

The so-called "Eng teak" is the wood of the large tree *Dipterocarpus tuberculatus*, which is found growing over several thousands of square miles in Burma. Its weight is from 50 to 55lbs. per cubic foot (as compared with 45lbs. for teak), and it is tapped for a yellowish-brown oleo-resin (*Eng dwe*), chiefly used for caulking boats and stopping cracks in canoes. Far from being preservative in its character, this oleo-resin tends to hasten decay. In Burma, Eng wood is used for house-building and planking of an inferior description, and for making canoes, which only last

from three to five years. Its wood is not durable, being soon liable to attacks by fungi and insects. But though unsuitable for use in any hot and damp climate, it may quite probably be found considerably more durable in Britain than in Burma or India; yet to attempt to pass it off as a kind of "teak," or as having any of the most valuable properties of teak timber, seems likely to mislead purchasers.

The so called "Yang teak," from Siam, is either the *Dipterocarpus tuberculatus* or one of the two very closely allied species *D alatus* and *D turbinatus*, the wood-oil trees known as *Kanyin* in Burma, and *Gurjan* in Bengal and the Andamans, from which a resinous oil is extracted and used for making torches and as an inferior varnish. This oleo-resin has also nothing preservative in its character, but also tends to hasten the decay of the wood. It is a magnificent tree of 150 to 200 ft. in height, and is found abundantly in the tropical hill forests of Burma, the Andaman Islands, Chittagong, and Cachar; but its wood, also weighing from 50 to 55lbs. per cubic foot, though used locally for house-planking, dug-out canoes and packing cases, is soon destroyed by white-ants, and it is not likely to be of any very durable nature even in Britain.

The so-called "Borneo teak" is the *Merbau*, or *Merabau*, of Borneo, the Malay States and Archipelago, and the Philippines. It is a tree of the genus *Afzelia*, of which there are several species, some of which also occur in the West African forests. It is a timber that seems in many ways suitable for the British market; but it has no affinity whatever to teak, and it should therefore be utilised experimentally on its own merits, without trying to introduce it surreptitiously under a wrong and misleading trade name.

The so-called "African teak" appears to be the tree known as *Iroko* on the West African coast, and intending experimenters with its timber may probably gain some useful information concerning it from the Commercial Intelligence Department at the Colonial Institute. Indeed, the collections of Colonial and Indian timbers exhibited there under the direction of Professor Wyndham

Dunstan, F.R.S., are well worthy of the attention of British timber merchants on the look-out for new kinds of wood suitable for our enormously absorptive market, without attempting to pass them off as varieties of "teak" in order to attract readier attention at first.

Yours faithfully,
J. NISBET,
Formerly Conservator of Forests,
Burma.

February 28th, 1914.

ROSIN.

We have to record very sensational fluctuations in this article, which resulted from the liquidation of the American Naval Stores Co., of Savannah. In March of last year this company, which was holding unusually heavy stocks, was compelled to wind up its affairs, and the forced sales of such large quantities caused a break in the market of from £4 to £6 per ton, and threw the whole industry into the most dire confusion.

The new crop, which was just commencing, was not at all excessive, and the consumption of the world was quite equal to the production, but the market was unable to absorb the heavy quantities suddenly forced upon it, and the price for the finest grade fell from 18*s.* 6*d.* c. i. f. to 14*s.* 3*d.*, and for the low grades from 16*s.* to 9*s.*

The outcome of this disaster has been that a large number of new companies have been floated in the Southern States of America, to handle the trade previously carried on by the American Naval Stores Co., and there is at the present moment most intense competition between these various corporations in their endeavour to establish themselves. Consequently, consumers have been able to obtain their requirements at very low prices compared with the past four years.

The position, in our opinion, has now become normal. The producers have determined to reduce the output of the next crop,

and have also kept back at the places of production in the interior considerable quantities of last season's make, and while it is too early to obtain reliable estimates as to how much under the previous crop the next season's yield will be, we think it is justifiable to say that no further decline in price need be anticipated.

We take a sanguine view of the situation, and recommend our clients to hold more ample stocks at present values, *viz*, 9*s*. 3*d*. per cwt. c. i. f. for the paper-making qualities, F. and G., and as regards the finer grades, the American market has already improved and is now firm at prices which are relatively too dear compared with French and Spanish.

It seems apparent that during the coming year the European buyers of the fine descriptions will have to use less American Rosin and more French and Spanish, as the probability is that the new crop of the pale grades in America will not leave any considerable weight available for export.

Consumers, however, are so well supplied, that they are not likely to evince any impatience in renewing their stocks, and it may be a considerable time before the looked-for advance takes place in the fine descriptions, but we confidently look for an immediate and steady improvement in the lower descriptions, and estimate that the Rosin now selling at 9*s*. 3*d*. will advance to 11*s*. 6*d*. during the coming year.—[*Indian Trades Journal*]

USE OF WOOD FOR GAS MANUFACTURE IN AUSTRALIA.

Times Eng. Suppl., Oct. 29, 1913. [T. R.]

In a paper read before the Victorian Gas Association, it was stated that wood is largely used, in admixture with coal, for gas-making in Australia, the proportion of wood frequently reaching 25 per cent Box and red gum wood have been found the most suitable, yielding about 12,000 cubic feet of gas per ton, having a calorific power of about 450 B.Th.U It was stated further that the use of wood has prevented the deposition of naphthalene in the gas plant and reduced the amount of "scurf" adhering to the retort walls.—[*Journal of the Society of Chemical Industry*]

HASTENING GERMINATION OF HARD SEEDS.

The seeds of many Leguminosæ, and particularly those of the Cæsalpinia and Mimosa plants, do not readily imbibe water, and therefore germinate slowly This defect may be remedied, says the *Gardeners' Chronicle* (quoting an article by E. Verschaffelt in *Rec. Trav. bot. Néerl.*), by treating the hard seeds with alcohol. The more rapid swelling which occurs when the seeds thus treated are placed in water is accounted for in the following way: The alcohol penetrates into the seed coat through the micropyle, or other minute openings in the seed coat, into which water cannot pass. Once the spaces in the coat are filled with the alcohol, water, which readily mixes with alcohol, passes by diffusion into the integument.—[*Pharmaceutical Journal.*]

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TEAK IN THE WYNAAD: A STUDY.

PART III.

(Concluded from the Indian Forester for June 1914.)

M. (C) REPRODUCTION OF TEAK FROM SEED.

42. As stated in para 35 there is little or no reproduction from seed.

As stated in para. 22 these forests are not only mature but overmature, and as shown in para. 39 in Table XVII an appreciable number of trees are without doubt of coppice origin. More than this, the mature trees all occur in small patches as referred to in para. 36. Putting all these circumstances together, it is not straining facts to suppose that the failure of teak to reproduce itself by seed is no new thing but is a phenomenon which has been the rule during at least the past 200 years. In view of this it is worth considering to what cause the failure of seedling reproduction can be attributed.

43. The following remarks deal with the North Malabar forests but those readers who are familiar with teak areas elsewhere must judge for themselves whether these remarks are capable of a wider application.

44. There is reason to believe that the local forest population (Kurumbers) was more numerous in the past than it is in the present, but the reasons for this belief are too long to detail here. This population has always been addicted to the practice of shifting cultivation (Takkal). The Kurumbers are divided into three castes or classes and each caste again into separate septs. These septs had and still have their well-defined local limits and they dare not encroach on the territory of another sept to practise their Takkal and other customs. Each sept had and still has its tutelary gods who are strictly territorial and local. Each sept therefore was obliged to quarter its territory pretty thoroughly and intensively. Thus very little forest escaped subjection to Takkal and its concomitants, serious and repeatedly recurring fires. The soil would have in consequence suffered from wash and denudation, but being so amazingly deep (para. 1) these destructive agencies had a less serious effect than would otherwise have been the case. But the surface soil invariably and continuously suffered injury. As the soil is of a very stiff nature, this harassment of the surface soil had a disastrous effect on the destruction of the tilth and depletion of the vegetable matter in the soil. Having arrived at this point, it is necessary to turn to the examination of a teak seed and see how such conditions affected it.

45. The fruit of a teak is so well known that it is not necessary to describe it in detail. With regard to the seed it is sufficient to draw attention to the felted outer covering, the hard and horny inner covering and (in proportion to the size of the seed) the ridiculously small embryo. It is necessary again to emphasise that teak seed does not improve with keeping, that it is liable to insect attack and is very susceptible to wet rot (*vide* para. 35). These are fundamental premises and the reader must pause and decide whether they are true or not, otherwise the argument will be obscured.

46. Now take some seed and germinate it. As this is an experiment take the easiest case and germinate it in a box of pure sand and water it regularly and in a correct degree. The

sand is used in order to allow the plant to develop as strongly and as typically as possible ; also to enable one to pull up the seedling "to see if it is growing" without endangering the result, so that it may be handled and measured without breaking any of its delicate tissues. The experiment has a two-fold purpose—to see what happens below the ground and to see what happens above the ground. But in order to arrive at all aspects of the case, let the seed be sown in the three possible ways in which it can be sown—

(*a*) wholly bury the seed in the sand,

(*b*) partially bury it, so that some portion of it may be visible, and

(*c*) do not bury it at all, but lay it on the surface of the sand. Lastly suppose that the seeds chosen are the best that can be selected. As we can never be sure of our time for a week together, it is good to add a glass cover over the box and place it in the sun to expedite matters.

(*a*) Above the ground.

(i) The unburied seed.—On the 8th day after sowing, germinated from the top. The radicle grew along and down from the top of the seed and reached the ground on the 2nd (10th day) after its first appearance. On the 14th day the seedling had entirely separated from the seed except for the cotyledons, the young stem was $\frac{3}{4}$ inch long to the junction of the cotyledons. At this date the first two leaves were distinctly visible and about $\frac{1}{8}$ inch long, the cotyledons being about $\frac{3}{4}$ inch by $\frac{3}{8}$ inch and rough : on the 19th day the cotyledons were quite free from the seed, the first pair of leaflets were well formed and were $\frac{1}{4}$ inch long.

(ii) The partially buried seed.—On the 14th to 19th day after sowing, the cotyledons may show either in the split of the seed or just at the ground level, according to the place where the seedling emerges from the

seed. Both *plumule and radicle were* bent and curved and now total about $\frac{3}{4}$ inch long, the stem from the collar to the top of the cotyledons being about $\frac{1}{2}$ inch long: the cotyledons have not become fully green but only so at their tips: they will be still closed together and measure about $\frac{1}{4}$ inch long *by $\frac{3}{16}$ inch wide and have not yet become rough.* The next day, the cotyledons opened, the young plant had not separated from the seed but so nearly so that although handled very gently, it broke away from the seed. On pulling up the seedling, the stem measured $\frac{3}{4}$ inch below the ground: the cotyledons *had developed stalks $\frac{5}{8}$ inch long to help in pushing* them above the ground: the first pair of leaves were just below the ground level and only showed as two thin brown lines: the cotyledons were still not fully green.

(iii) The wholly buried seed.—Germination was apparent *on the 15th day after sowing, it had germinated* from the bottom and the first signs of it were the appearance of the two cotyledons breaking their way up through the sand: they were fleshy and bright green in colour. Two days later, the top of the plumule was turning green and the collar was $\frac{1}{4}$ inch *below the ground.*

(*b*) Below the ground.

(i) When pulled up 14 days after germination was *observed, the root was $2\frac{1}{2}$ inches long with 8 root*-hairs all situated on the upper half of the root, the longest being nearly $\frac{3}{8}$ inch long.

(*ii*) *If pulled up just as germination is indicated, the root* will be found to be about $\frac{1}{4}$ inch long: it may have as many as 3 root hairs just barely visible to the eye and situated immediately below the collar. If pulled up when separation occurs, the little tap-root will be about $2\frac{1}{2}$ inches long: the root-hairs will be found

to be only developed on the upper half of the root, in some cases only along the top half inch. The longest root-hair will be about $\frac{3}{8}$ inch long.

(iii) When pulled up about the 15th day after sowing, the tap-root will be about $2\frac{1}{2}$ inches long, with some 10 little root-hairs only on the top $\frac{1}{2}$ inch measuring from the collar and perhaps two more forming about 1 inch down from the collar. Longest root-hair about $\frac{1}{4}$ inch long.

The above, though actually observed, are merely adduced as fairly typical of what occurs and as portraying the nature of the young seedling during the first two weeks of its life. The root dimensions as given are excessive for actual soil practice because the sand allows of quicker and freer growth than would be the case with any forest soil. Owing to the glass cover, the periods given are shorter than in actual practice, both as regards germination and times of development in growth. For instance in actual practice in a nursery, germination may be given from ten days to four weeks before one begins to become nervous about the success of the nursery.

47. For the purposes of this argument the experiment need be carried no further than the above has been taken. It may be added here that the cotyledons persist for about one month beyond the period examined and that the seedling has two critical periods: the first period being that prior to germination of the seed owing to the doubt whether it will prove fertile or not, the second at, and just after, the time when the seedling separates itself from the shell of the seed.

48. In considering this problem of the obstinate refusal of teak to reproduce itself from seed, there are two methods by which it can be simultaneously attacked. In this, as in all local problems of a baffling nature, one may trust to one's intelligence and skilled knowledge (such as it may be) to work out the riddle and one may at the same time look around and ascertain what causes have been assigned elsewhere for similar failures. But in this latter case having ascertained the reasons given, it is necessary

to be careful to bear in mind the special local factors which present themselves in the course of one's own problem. The process of elimination is a very useful one in such an enquiry and it is proposed to adopt it in this case.

Among the reasons which have been assigned for the failure of teak seed to germinate naturally elsewhere, the following occur as some of the favourite theories on the subject :—

(*a*) Failure due to successful fire-protection.—It is known that from 1860 till a comparatively recent date, the forests have been subjected to annual fires. As shown in para 44 it is also probable that the forests have been steadily burned for the past 150 or 200 years, in view of our experience of the reasonable certitude that fires are a concomitant of shifting cultivation. Until comparatively recently, there has thus been a complete absence of successful fire-protection.

(*b*) Failure due to toxic properties being formed in the soil as the result of a succession of generations of Teak.—In the same soil which supports successful reproduction where nurseries are formed or where seedlings are artificially introduced, natural reproduction from seedlings is absent. The soil therefore is not toxic against teak, nor is it in any way "teak sick."

(*c*) Failure to reach mineral soil.—In consequence of the successful fire-protection of later years the leaf fall is only just beginning to show indications of forming leaf mould. Consequently there has been no inability of the seed in the past to reach the mineral soil.

(*d*) Failure owing to water-logging of the soil.—Wherever teak seedlings are introduced artificially (in any reasonably likely spot) they grow.

(*e*) Failure due to defects in the seed owing to the age of the trees or by reason of the trees being crooked, stunted, or unsound. The trees are of all ages and of all habits of growth: when the seed is collected

from these trees and artificially sown, the seeds germinate in sufficient numbers to preclude any theories against their germinating when they fall on the ground in the course of nature

(*f*) Failure due to sufficient time not having elapsed to eliminate the characteristic (which is supposed to have been acquired in some mysterious way), which causes the seedling to die down again and again before finally establishing itself.—The want of seedling reproduction has been noticed for a sufficient number of years to enable it to have had time to have surmounted this characteristic which has been ascribed to teak.

49. The real cause of the failure of the teak to reproduce itself naturally from seed is such a simple one that it will probably not be readily acceptable. It is due simply and solely to the entire absence as yet, of a tilth on the forest floor. The fault lies only in the surface soil which is unable to provide the factors necessary for a teak seed to germinate and grow. Where the soil is hard and compact the tender root system is quite unable to penetrate it. The root-hairs are too weak and too delicate to force their way into the soil and the baby plant dies of want of nutrition before these root-hairs can take the hold required to nourish the plant. Where the soil is free, the interstitial water is incomplete; there is no movement of water in the soil owing to the absence of a tilth and the plant withers away, as its reserve food is inadequate to tide it over the crisis of its first struggle for existence.

50. Summing up the foregoing remarks the indications are :—

Firstly, as per various preceding paras. the soil is of a stiff cold nature, the past history indicates that shifting cultivations and fires have exposed the soil and prevented the formation of humus, the heavy rain has washed the soil, which tendency has been aggravated by the exceedingly hilly nature of the country. The strong winds have secured access to the surface soil and tended to dry it up as the absence of tilth has destroyed the upward flow of

moisture and disturbed the proper balance of the interstitial water in the soil.

The want of humus noticed above leads me to deal with another theory which has been put forward. It has been noticed in many places other than the Wynaad that the leaf-fall of any year completely disappears and the ground later on is found quite bare again. This has been ascribed to the action of white-ants, which seems on the face of it rather a far-fetched idea. We all know what is meant by a "hungry soil." This bareness of the ground is due to so many of our forest soils being "hungry" for organic matter. The leaf-fall (where it is not destroyed by fierce fires or even by ground fires which some people assert to be so harmless) has *not* been eaten by white-ants but has been absorbed by the soil and so to speak greedily eaten up by it in its effort to satisfy itself of its hunger for organic matter : and this process may be expected to continue until the balance of organic matter, which the soil must and ought to have, has been restored

Secondly, the supposed experiment, based on fact, referred to in para. 46, discloses the following important characteristics of the germination and early growth of a teak seedling :—The very small embryo develops (for its size) a very large and stout radicle, which certainly gives the radicle a proportionately great penetrating power but causes it to quickly use up its reserve supply of food : the radicle is further handicapped in its endeavour to secure a good anchorage for the plant by its inability to develop with sufficient rapidity a strong system of root-hairs to feed it and the young plant : to make matters worse, these root-hairs are not produced along the greater part of the length of the root but are only concentrated on the upper one-third to one-half of its length : the root-hairs in their earliest stage are very weak and have little or no penetrative power. Again, the first leaves of the seedling give it but little support during its first struggle for existence; the cotyledons are small and soon fall : the plant does not during its most critical period produce more than three pairs of leaves at the most and these leaves remain so insignificantly small as to afford but a meagre assistance to the seedling during its endeavour to develop

its baby root system: these leaves moreover are so crinkled and harsh, as to become easily coated with mud in rainy localities and fall quick victims of suffocation. In short, in all but a specially suitable surface soil and a nicety of moisture, there is every reason why the seed should fail to germinate and establish the seedling: the only point to be surprised at is that under existing conditions of the forest floor it is ever able to do so. It is for these reasons that teak is among the most obstinate of all our forest trees in reproducing itself from seed and why we must expect it to be among the last of all our species which will yield results in this respect. Rome was not built in a day and it will be many days before we can be sure of getting natural reproduction of teak from seed, but that does not mean we shall never get it or that we are to suppose that the problem is either a hopeless one or a very complex one.

51. In the light of the above, the conditions necessary for the natural reproduction of teak by seed are—

(*a*) organic matter in the soil,

(*b*) a fine tilth on the surface, and

(*c*) a proper degree of moisture. Nothing more than this is needed and the only way to get it is time, patience and really successful fire-protection.

As soon as our forest soils obtain the organic matter they need, they will cease to be "hungry" and will devote themselves to forming a tilth. When these two factors have been established the interstitial water will be restored and the movements of water in the soil will become active.

There seems to be one and only one way of securing these three absolutely essential conditions and that is absolute fire-protection, by which is meant real fire-protection: protection of such a rigid nature that no fires occur at any time or in any place. Then the element of time comes in. For the degree of protection from fire being absolute, for every small area in a locality it will depend entirely to what degree its soil has become deteriorated In those areas where deterioration is worst, Fire-protection must be carried out for a longer time than in those where the deterioration

is less or much less. Lastly the human element of patience is essential. It is no use kicking against the pricks: nature laughs at all such futilities. It is unreasonable, unscientific and illogical to expect to see results within such a short space of time as five years or ten years. Even on a farm which may have unlimited money spent on it and where thorough and close cultivation may be practised, it requires three to seven years to bring round a soil which has got " out of heart. "

If there is any method for securing the above three essential conditions in a forest other than fire-protection, let it be ascertained and thoroughly investigated. Meantime it is our bounden duty to see that fire-protection in mixed timber forests is rigid and well carried out: to set our faces against any slackness on untrustworthy reports; and to insist that when a fire occurs its real extent is accurately investigated and measured on the ground and as correctly as we are able to record every fire on the fire map for future information. Until this has been done, no man can say that absolute fire-protection is or has been a failure because nothing can have failed unless and until it has first existed.

52. Supposing the problem to be as stated, there will still remain elements of uncertainty. In a wet district there is the danger of the seeds rotting. In a dry district there is the risk of a drought coming at the critical stage when the seed has just germinated: no matter how free the soil or how good the tilth may be, the little plants will wither away whenever such an event occurs. In all districts, there is the uncertainty of the seed year. So even when all the three conditions which are essential have been fulfilled, we shall be fortunate if in India we can secure the natural reproduction of a teak area in less than the 20 to 30 years allowed for the similar process of the natural regeneration period in a forest in Europe.

53. There are two critical periods when the success of the reproduction will be in danger. The first before germination as is the case in wet and very wet climates: and the second during the three to five months after the young seedling has separated itself from the seed as is the case both in wet and dry climates The fact of

young plants dying back year after year until a year comes when they are able to establish themselves seems to admit of an easy explanation. The cause of this action on the part of the plant is due not to any lately acquired characteristic but to the root system not being able to establish itself: and in its effort to do so, the shoots which have sprung up are insufficiently nourished to survive and they are unable to contribute their share towards the mechanism of the plant: in short the free movement of sap is interfered with. When, at last, the root system has obtained a sufficient grip of the soil, the shoots which are then in being, receive the nourishment they require; are able to perform their duty and the circle of life is complete with the result that the plant becomes established. In the case of root systems which are already well established as when a grown tree is felled, the shoots spring up strongly and there is no question as to their survival.

Since we have to depend upon nature for rain it may be argued that it does not matter whether we know of the critical periods or not or when and how long they last. But it matters a very great deal. In the one case we know what the cause is and why it is beyond our control, in the other case we can only guess at the causes of failure and it is open to any person on his mere *ipse dixit* to deny the source of the causation. Further if we are sure of the cause, we shall then develop the patience to await the good year required and we shall have certain knowledge that it will come.

54. In the light of this argument the high winds referred to in para. 1 became an important sylvicultural factor not only in the consideration of teak but of our forests generally. In the Madras Presidency, if not elsewhere in India, there are few localities which are not subject to these high winds: they blow for periods of three to five months together: their cumulative effect is prodigious. If and when we see the all important tilth just beginning to form, it is to say the least extremely annoying to find that much of it is blown away by these ruthless winds. The soil is thus not only denuded of its tilth but it is exposed to the drying influences which these winds bring in their train. Here then we find the value of and the necessity for closely studying the undergrowth. For the under-

growth not only helps to make and fix the tilth but it conserves the moisture which would otherwise have been drawn out of the ground. Where we are fortunate enough to have a close canopy, it is folly to recklessly open it and suddenly expose the soil.

N.—ARTIFICIAL REPRODUCTION OF TEAK.

55. If it has been correctly stated that most of the young teak is due to root-suckers and if it has been correctly inferred that some years must yet elapse before seedling reproduction can be expected, it is clear that teak is a very local tree, and will remain so as long as the existing state of affairs lasts. For, no matter whether the tree coppices or root-suckers, the new growth can only occur when there is an existing root system and not beyond it. The tree will be able to extend itself naturally to any appreciable degree only after its seed can be relied upon to grow and establish itself. It is not therefore necessary to introduce teak where there are existing root systems but only in those spots where there are none in the teak zone. For this one reason alone then, any system of artificial reproduction by Taungya or kindred operation is at once discounted. Such operations may indeed be carried out in small areas of an acre or so, but it would be intolerable to allow a number of them to be carried on in small scattered patches in an area where absolute fire-protection is the first desideratum. Fortunately also there is no temptation to hanker after any such method of artificial regeneration because, as apart from any of the above considerations, it carries its own disablement with it. Such a system required a large establishment to carry it out successfully and the more successful the operation may be, the larger must become the establishment necessary to foster its further success. Not only has the Taungya to be established but when established each portion of it has to be thinned and otherwise looked after at least once every five years. But as it is not likely that any sufficiency of supervisory establishment can be obtained, there is an end of the matter. At the best, Taungya regeneration can only be at its best when carried out in pretty large and compact blocks. But as shown throughout this argument, this is precisely what is not required. Where teak

root systems are already established, they can be trusted to reproduce themselves when the soil conditions become suitable. The problem that has to be faced is that of introducing teak into those portions of the teak zone where there are no existing root systems. This can be done by the Spessart or Group system. In between those small places where groups of teak already exist can be found other places where there are none. It is in these void (of teak) spaces that the teak seedlings should be artificially introduced by means of little groups of 12 to 40 plants. If only one of these seedlings mature, a root system has then been introduced where there was none before and the forest is permanently richer to that extent. The operation is a very cheap one. If successful it not only fulfils its purpose, but it has the advantage of requiring a very small establishment to carry it out and not much cooly labour—a consideration both of money and men in places where money and labour are scarce Two points have to be emphasised in connection with this matter. The seedlings will probably take five years (or even seven) to establish themselves and consequently, as the second point, the enumeration of the seedlings after the first year must not be taken as a test of the success of the operation: it will probably be found that more plants can be counted after the lapse of the second or third year than after the first year: the reason being due to the struggle of the small root system to establish itself (para. 53).

56. In point of fact, in the Wynaad a second method of artificial regeneration is being adopted. When the trees are felled in a coupe, the brushwood is collected into heaps and burned and teak seed is sown in the ashes. In this case, care must be taken to thoroughly break up and *pulverise* the ground in each individual little patch where the seed is sown. The success of the operation therefore depends on the man who sows the seed: if he fails to pulverise the ground thoroughly, no seedling will result. The objection to this method is that many of the trees which are felled are teak trees and if success follows the sowing teak is being introduced where a root system exists already. However this cuts both ways, because many other of the trees felled are species other than teak and they may and mostly do stand outside and beyond

an already existing teak group. To counterbalan ce any objection against this method, the expenditure is very small and much inflammable material is put to a useful purpose instead of being allowed to remain as a menace to the forest. The method has only been seriously attempted during the past two years and but little success is claimed as a result so far : as time goes it will be ascertained which men can be entrusted with the sowing and which cannot and it can then be judged whether this method is worth continuing.

57. Supposing that the teak can be thus artificially introduced with reasonable success by these two methods or any other methods, it will remain for determination how far it is advisable to introduce the teak and to what percentage of the general crop. Judging by the proportion of the older teak now growing in the richest groups, it will be quite safe to introduce the teak throughout the whole teak zone up to 25 per cent. of the entire forest crop. The chief local danger to teak which has occurred in some small plantations raised some years ago in the district is the defoliator. The best remedy against this pest is the ordinary crow. This bird considers the caterpillar a most succulent morsel and greedily snaps it up and eats it as it hangs in the air by its thread from the branches of the trees. Every endeavour therefore should be made to attract the crow into the forest and having got him there, to be sure and keep him, by artificial feeding if necessary, during that part of the year when the caterpillar is not available. However it will be many years before teak will have become artificially introduced evenly throughout the teak zone, so perhaps it will not become necessary to meet trouble half-way : though it is always an advantage to know how an enemy may be defeated.

O.—CONCLUSION.

58. In a paper of this nature, it is permissible to close with a personal note. Only those readers who have attempted similar work will appreciate the enormous labour involved in the preparation and the assembly of the figures contained in this study. It will be manifest to everybody however that the work could only

have been carried out with the co-operation of all grades of the range staffs and also by no means least, by the cordial co-operation of the clerical staff of my office. In the case of the range staffs it may be granted that some of the work has been merely an expansion of work which ought to be done in any case. The reader must judge for himself how far this is true. With respect to the clerical staff it is quite otherwise. In their case, the work has been entirely overtime work. Such work as this is not provided for when the strength of an office establishment is calculated for sanction. No one will therefore grudge me this opportunity, and the pleasure it gives me, of thanking my office establishment for the interest and care they have taken in helping me with a work which has been spread over a period of five years and which has had to be done at odd times and whenever time has permitted, in the intervals of the increasing pressure of their regular work.

59. As regards the figures themselves it is again emphasised that they are at best only a commencement of a local study and make no pretence to finality on the subject. They have been presented in as accurate a form as possible. Time and again, when any one of the above Tables was thought to be complete, a flaw has been discovered in it and the construction of the Table has been worked up again from the outset. Whatever may be the inherent disabilities of the Tables, the reader has the assurance that want of care in their preparation has not been one of them.

60. My object in sending this paper to the *Indian Forester* has been two-fold. First to let other Foresters, who are interested in the subject, know what has been done elsewhere in one small corner of India and to present them with a *précis* of the results which have been attained up to date and for what it is worth. Secondly to raise trains of thought in connection with problems of an analogous nature which are being studied in other localities.

61. To conclude, there is one and only one way of making any real progress in the study of teak or any other tree: and that is to ascertain what are the principles which govern the welfare of the tree in its various stages. For this purpose it is necessary to collect

and examine details. But these details are necessary not as mere details among which to lose one's balance and go astray on side issues but as bases on which to build up and formulate the principles. As each principle emerges, the details which built up this principle must then be put aside and fresh details must be planned until other principles become clear. And so on, until such a sufficiency of principles shall have been collected as shall constitute a complete mastery of the subject.

Lord Bacon was a man who has exercised a profound influence on the methods of latter day research. Let us not forget his dictum that "we can command nature only by obeying her."

F. FOULKES,

(*Concluded*). *North Malabar*

LIST OF THE TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN FOREST CIRCLE OF THE C. P.

(PART V.)

[*Part IV appeared in June* 1914.]

XXXVIII. PLUMBAGINACEÆ.

Plumbago zeylanica, *L.* Chitrak, *Vern.* (*Graham.*)

A shrub with long rambling green branches, very glandular towards the inflorescence, alternate ovate or ovate-oblong leaves and long panicled spikes of pretty long-tubed white flowers. ·5—·75" diameter, easily recognised by the persistent ·5" calyx covered with stalked glands. Filaments slender free with purple anthers.

Fls. *July—Dec.*

In open rocky places but not common. Graham says that the plant is used in Nagpur as a dressing for enlarged glands

XXXIX. MYRSINACEÆ.

Embelia robusta, *Roxb.* Baibarang, *H.*; Bawrin, Wauring, *Mar.*; Kopedilduli, *Gond.*

A shrub or small tree with light grey lenticellate branches, alt. ell. or obovate acuminate or obtuse leaves 2—6″ with a very short rusty pubescence when young and with minute red glands.* Pale beneath and glabrous in age. Fls small diœcious greenish white in axillary and extra-axillary racemes ·5—1·5″ long with gland-dotted calyx. Frt. red sub-globose ·12—·17″ diam.

Fls. *May—July.* Fr. *Dec.-Jany.*

Not uncommon in shady places. N. Chanda and S. Chanda, common; Bhandara; Balaghat; N. Wardha.

The fruits are used medicinally

Ardisia solanacea, *Roxb.* (Syn. A. humilis, F. B. I.), Budhara, *Chh.*

A shrub or small tree attaining 25 feet with large, bright green rather fleshy leaves 4—8″ narrowed into a petiole ·25″ long, clustered towards the ends of the branchlets. Moderate-sized pretty rose-coloured waxy flowers ·75—1″ diameter with yellow stamens, in axillary peduncled often contracted racemes. Berry ·3—·5″ diameter, depressed globose, black when ripe.

Fls. *April-May.* Fr. *Oct. Jany.* Evergreen.

Along streams, Machligutta forest (S. Chanda), South Sihawa (Raipur); Lormi Range (Bilaspur) frequent.

XL.—SAPOTACEÆ.

Bassia latifolia, *Roxb.* Mohwa, Mahua, *H.*, Guli (the fruit) Irku, irup, *Gond.*, Ippa, *Tel*

A large tree with the leaves clustered towards the ends of the branches and numerous ovoid campanulate cream-coloured flowers on long rusty tomentose pedicels fascicled at the leaf scars.

Bark nearly smooth brown. Blaze thick red beneath the thin outer brown layer, exuding a milky juice.

Fls. *Feby.—April.* Fr. *June—August.*

It is more or less leafless at the time of flowering, but flowers with new leaves in April. A well-known and very common tree in all divisions Corollas eaten raw and cooked (after drying). A

* Sometimes only visible on the margin when the leaf is held up to the light.

spirit is also distilled from them. The fruit is eaten. A cooking and lighting oil is expressed from the seeds, the value of which has risen considerably in recent years. The wood is good, and is used for oil-mills, and in building for beams and chowkats.

The tree is easily grown from seed and coppices well if felled in the hot weather, but not in the rains.

Germination hypogæal.

Mimusops hexandra, *Roxb.* Khirni, *H., Mar.;* Manchi pala, *Tel.*

A large tree, with rough grey bark and bright crimson blaze exuding drops of milky juice (attains 7 feet. in Sironcha) or flowering as a *shrub* in some localities L. alt. obovate-oblong obtuse or emarginate 2—4" shining crowded at the ends of the branchlets. Flowers ·25" diameter, white or cream, peduncled, in axillary fascicles, rotate, with 6 calyx lobes and multiples of 6 petals.

Berry ellipsoid ·5".

Fls *Nov.-Dec*, also *June* Fr. *April—June.*

Along sandy nalas in N and S Chanda, frequent; Sirpur Range (Rai.).

In very dry places, often only a shrub. Does well also in lime soils and is common on the marl in the Sattara forest. There may be two varieties: (*a*) a large, May-June, flowering form with tomentose pedicels and calyx, and (*b*) a smaller, Nov.-Dec. flowering form with nearly glabrous pedicels and calyx.

Fruit eaten.

Mimusops Elengi, *Roxb.* with elliptic or oblong finely nerved leaves 3—4" long and a yellow ellipsoid, or ovoid seeded fruit 1' long, is very common in gardens.

Fls. Fr. *March-April.*

XLI.—EBENACEÆ

Diospyros Chloroxylon, *Roxb.* Tupru (Sironcha); Andoli, *Mar.*

A shrub or small tree with rough dark grey bark and branches often armed with stout thorns. Branchlets rusty tomentose. L.

1—2" or attaining 2·25 by 1·75" ellip. or obovate obtuse with rounded base, pubescent. Flowers, very small, white, 4-merous.

Calyx strigosely hairy ·3" diam. in fruit. Fruit 3" diameter.

Fls. r. s. Fr. *Dec.—April.* Evergreen ?.

Common on cotton soil, N. and S. Chanda.

Diospyros montana, *Roxb.* Bistendu, *H.;* Ektemru, Wietemru, *Mar.;* Michi timri, Muchhi tumri, *Gond.;* Macha tunki, *Tel.*

(Brandis and F. B. I. include also D. cordifolia, *Roxb.* which is quite a distinct tree, under this species.)

A small or m. s. tree, attaining 4 feet girth and 30 feet high, with green or reddish exfoliating smooth bark, often armed with large conical thorns. Blaze with a green chlorophyll layer, then yellowish. L. 2—4" when in flower, attaining 6·5 by 3·5" in old leaves, glabrous or pubescent, base obtuse rarely slightly cordate or acute. Petiole ·15—·3" long. Male flowers in simple 3-fld. or compound cymes, ·25—·3" long and broad. St. in pairs 12—16. Fem. fl. solitary axillary, green or yellow, with four large rounded lobes. Staminodes 2, 4 or 8, usually 4. Fruit, globose or ovoid greenish-yellow, finally black ·7—1" diameter.

Fls. *March—May.* Fr. *Nov.—Jany.*

There appear to be two varieties which pass into one another :—

(*a*) Leaves always quite glabrous with very reticulate fine venation, more membranous than the next. S. Chanda.

(*b*) Kanjilali (Duthie *sp. in parte*). Leaves pubescent or glabrescent, often more coriaceous when old, more grey in appearance.

This and intermediate forms have been collected from Bhandara (Gotangan), Bilaspur (Lormi), Raipur (Harathema forest, Sitanadi) and S. Chanda. The species occurs in all divisions. The wood is hard and strong, but not much used. The fruit is said to be poisonous.

Another very thorny Diospyros with very pubescent or hairy, sub-membranous ell.-oblong acuminate leaves 6—7·5" long, may be a new species, but it has not been collected in flower or in fruit, Raipur.

Diospyros melanoxylon, *Roxb.* (including D. tomentosa, *Roxb.*) Tendu, *H.;* Temru, *Mar.;* Tumri, *Gond.;* Tunki, *Tel.*

A small to large tree (attaining 6 feet girth) with black bark breaking into rectangular scales. Blaze black and grey streaks, then striated pink, finally chrome yellow. L. mostly opp. or sub-opp. broadly elliptic to sub-orbicular with rounded base 4—12" more or less hairy or tomentose beneath with strong 6—10 prs. sec. nerves. Excessively variable. M. fls. in peduncled tomentose cymes. Calyx funnel-shaped acutely toothed. Cor. tubular. Fem. solitary, calyx attaining 1 diameter in fruit. Fr. 1—1·5 diameter smooth and yellow when ripe.

Fls. *April-May.* Fr. *May* (following). Nearly evergreen.

Common everywhere, attaining its largest dimensions on metamorphic rocks in the saddles of the hill ranges.

It reproduces itself copiously from root-suckers and coppices freely. It is highly prized for poles. As a fuel the showers of sparks emitted are against its use. The fruit is excellent, and as one-seeded berries occur, it would probably re-pay cultivation.

(With regard to the separation of D. tomentosa and D. melanoxylon, *vide* "Forest Trees," "Indian Timbers" and "Flora of Chota Nagpur." Var. Melanoxylon has generally narrower leaves, often acute base and apex, and is said to have the sec. nerves raised above, whereas Var. tomentosa has usually rounded or obtuse leaves and sec. nerves impressed above. Both varieties occur 'mixed' up and seem to me often indistinguishable, but *tomentosa* is perhaps more eastern in its distribution.)

Diospyros Embryopteris, *Pers.* Maka Tendu, Kala Tendu, Gab, *H.;* Timburi, *Mar.;* Niti Tunki, *Tel.*

A handsome tree with low spreading branches almost to the ground, smoothish black bark, and large coriaceous oblong narrowly oblong glabrous shining leaves 5—9" long or more. M. fls. white fragrant in axillary usually 4-fld. umbellate cymes. F. fls. 1" diameter solitary. Conspicuous in fruit from the large globose berries 2·5—3" diameter rusty red from the tomentum.

Fls. *April-May.* Fr. *Jany.—April.* Evergreen.

Along nalas only, especially deep ravines in hill ranges.

S. Chanda, frequent; Raipur, frequent (Baloda, Barbhum, Mawarpathra, Maramsil); Bhandara (Nishami Hill forest).

The fruit is exceedingly full of tannin and is only eaten by monkeys.

XLII.—OLEACEÆ.

Jasminum arborescens, *Roxb.* Jagkahi, *Chh.*; Amjin, *Bhumia.*

A woody climber, or sometimes sub-erect with trunk attaining 2 feet girth and long drooping branches. Leaves and cymes pubescent, or nearly glabrous in fruit. L. simple, opposite, 1·5—3" at the time of flowering, attaining 5 by 3·5" (sometimes even 7"), mostly acuminate. Petiole ·25—·3" in flower or attaining ·75" in age. Fls. white, in lax 7 (rarely 3—5-)-flowered 3-chotomous cymes. Calyx lobes linear ·06—·12" (or ·19" in fruit). Corolla tube ·5", lobes ·5—6". Ripe carpel ·5" black oblong or ellipsoid.

Fls. *April-May.* Fr. *June-July.* New shoots *March-April.*

Not uncommon in the moister forests, especially near nalas and rocks. In all districts.

Jasminum auriculatum, *Vahl.* Sanmogra, *Mar.*; Jaibelhi, *H.*

A woody climber with ovate or cordate leaves ·5—2" long, obtuse, mucronate, tomentose, when young, pubescent when old. The leaves are really compound, but the lateral leaflets are usually absent or reduced to ovate auricles, they may, however, attain ·3". Petioles (including rachis of compound leaves) ·1—·2". Fls. white ·3—·4" diameter in close short panicles. Calyx lobes united or free portion only ·04" long. Fruit globose ·25" diameter, seated on the slightly enlarged calyx.

Fls. *July—Sept.* Fr. *Dec.*

On sandstone, S. Chanda, frequent.

Var. glabrior.

Leaves a darker green, glabrous or puberulous even when young, ·3—1·5." S. Chanda (Dhaba).

Nyctanthes Arbor-tristis, *L.* Harsinghar, Karasli, Sephalika *H.*; Khursi, *Gond.*, *Tel.*

A small tree with weeping 4-angular branches, very scabrous ovate-entire or toothed, acute simple leaves and white salver-shaped flowers with yellow tube in bracteate heads and ample terminal 3-chotomous cymes. Capsule orbicular compressed leathery 2-celled.

Fls. *Sept.-Oct.* Fr. *Dec.—Feby.* Deciduous *April-May.*

Frequent on rocky hills and in second-growth forest, and often gregarious. All districts.

Schrebera swietenioides, *Roxb.* Mokha, *H*, *Mar.*; Ghanta, *Chh.*; Mokhaim, *Tel*

A moderate sized tree with opp impari pinnate leaves with 3—7 leaflets 3—5" by 2—3" oblong to ovate lanceolate, pale beneath, lateral narrowed into a very short petiolule. Fls. ·5—6 diameter with minute brown scales in terminal 2—3-chotomous cymose panicles. Capsules 2·5 by 1" pyriform with small warts, 2—4 angular seeds in each cell.

Fls. *May-June* with the young leaves. Fr. *Oct.—March.* Deciduous. *Feby.-March.*

Common in all districts. Poles used for building.

Linociera intermedia, *Wight.* Kunrwan, *Chh.*; Dili, *Tel.*

A small glabrous tree attaining 3 feet girth with narrowly elliptic oblong to ell.-obovate leaves 3·5—8" by 1·25—3" and axillary pyramidal panicles 1·5—4" long of small white fls. in sub-sessile clusters on the opposite branches. Drupes ·5 long purple-black.

Fls. *Feby.-March.* Fr. ripening the following *Feby-March.* Evergreen. Renews leaves *February.*

Raipur, common in some of the nalas of Singpur and Sihawa; South Chanda and Aheri, in deep nalas.

XLIII.—APOCYNACEÆ.

Carissa spinarum, *A. DC.* Jangli Tondi, *Mar.*; Karaunda, *H.*

An erect, often bushy shrub armed with long usually forked spines 1—2 long. L. opp., entire ·5—1·5" pale beneath mostly acute and apiculate glabrous. Flowers small white star-like ·25—·3"

diameter with tube ·25 long or rather larger in 3-chotomous cymes. Sepals subulate acuminate. Berry ·25″ diam. sub-globose.

Fls. *March—May*. Fr. *Nov.-Dec.* Evergreen.

Not very common, chiefly on sandy soils. Alesur Block (Bh.); Kurmur, Niwas, etc., on Baihar plateau (Bal.); N. Chanda.

The fruit is edible.

Carissa Carandas, *L.* Karaunda, Kati Kandhori, *H.*

An erect or large spreading and sarmentose shrub with large straight single or 3-fid. thorns, ovate or ell. or oblong shining leaves 1·5—3″ long, very short petioles and terminal puberulous sessile or peduncled cymes. Calyx pubescent, corolla tube ·5—·75″. Berry ·5—1″.

Fls. *March-April.*

Cultivated. The large sarmentose form near Telenkheri (Nagpur), comes very close to *suavissima*, Bedd., but the calyx seems more pubescent and less acuminate, leaves less acute, and the *thorns* are *straight*.

Plumeria acutifolia, *Poiret.* Champa, *H.*—is a small tree often grown in gardens. It has round very thick branchlets and large cream and yellow flowers in 2—3-chotomous cymes. Deciduous in the hot weather.

Alstonia venenata, *Brown.* Var. pubescens.

A shrub with pubescent branchlets, lanceolate whorled leaves 3—5″ long and terminal corymbose panicles of salver-shaped flowers with slender tube ·75″ long and petals ·5″ long. Fruit of two slender follicles. The leaves have numerous regular parallel spreading sec. nerves, and there are several linear-subulate glands between the petioles.

Fls.—*July*. Fr. not seen (in C. P.)

Found by Mr. Donald in Allapalli and on cliffs in Sironcha. The plant was named at first 'neriifolia,' *Don.* between which species and 'venenata' it is intermediate. If, however, the two species are reduced to one, as has already been suggested by Sir D. Brandis in a note at Kew, then 'venenata' is the older name.

Alstonia scholaris, *Brown.* Chatwan, *H.*

A tree with whorled quite glabrous leaves, 4—7 in a whorl, 4—8″ long and large umbellate paniculate cymes of greenish-white flowers.

Fls. *Nov.-Dec.* Fr. r. s. Evergreen.

Not wild in the circle but often planted. The climate is generally too dry for it and it never grows well.

Holarrhena antidysenterica, *Wall.* Kura, *H.*; Indarjhao (the seeds) *H.*; Kudla, *Mar*; Samoka, *Gond.*; Guda pala, *Tel*

A large shrub or small tree with glabrous or pubescent sub-distichously spreading sub-sessile ovate to ell.-oblong leaves 6—12″ by 1·5—5″ strongly nerved (8—15 pairs) beneath and terminal corymbose cymes of sweet scented white flowers, ·75—1·5″ diameter. Stamens not exserted. Fruit of two slender divergent follicles 6—9 long by about ·16 broad.

Fls. *April—July.* Fr. *Dec. Feby* It is deciduous in the hot season and flowers on the new young shoots.

In all divisions, especially in the damper localities (but the pubescent form is common on Ramtek Hill (N W.); often in waste ground.

An excellent cure for chronic dysentery.

The pubescent form appears to be the more common.

Wrightia tinctoria, *R. Br.*

A small usually pubescent tree with sub-sessile elliptic-oblong to oblanceolate leaves 4—10″ long (always quite small when in flower) and corymbose cymes of pretty white flowers, ·5—·75″ diameter conspicuous for their corona of linear scales and exserted cone of yellow anthers. The leaves have always a sudden short acumination, the young ones dry, more or less blue, with reddish veins beneath. Follicles 10—20″ long, always curved and cohering at the tip until nearly ripe.

Fls. with the very young new leaves, *March—May.*

Usually on dry sandy soils and hills.

Partabgarh Hills (Bhandara); N. and S. Chanda, frequent; Laon Range (Rai.); Nag. Wardha. Southern specimens are all pubescent, but I collected a glabrous form from the Pachmarhi Hills.

Wrightia tomentosa, *Roem* and *Sch.* Pailari, *Gond;* Kala Indarjhao, *H.;* Pandu Kura, *Mar.;* Tela Pala, *Tel.*

A small tree with yellowish or milky juice, slender, pubescent branches and distichous elliptic shortly caudate tomentose leaves 3—5″ long with 8—14 pairs strong secy. nerves. Fls. 1″ greenish orange or cream-coloured with red coronal scales, in tomentose corymbose cymes. Follicles connate into a grooved pendant cylindrical pod about ·5″ thick.

Fls. *April—June*. Fr. *Dec.—Feby.* Deciduous *Feby.-March.*

In valleys, not very common. S. Sihawa (Rai.); Dhansua Range (Bal.), S. Chanda.

Tabernæmontana coronaria, *Willd.* Tagara, Chandni, *Vern.* is a handsome evergreen shrub, with glossy leaves and white flowers ·5—1″ diameter which are often double. It is commonly grown in gardens and sometimes called a 'Gardenia,' from which it is at once distinguishable by its milky juice, apart from its entirely different floral structure.

Vallaris Heynei, *Spreng.* Dudhbel, *Mar.;* Pala tige, *Tel.*

A climber with light grey tough cord-like stems, though sometimes found in a semi-shrubby state in open ground. Leaves light green, oblong to elliptic, shortly acuminate, nearly glabrous 1·5—4″, membranous, sometimes pellucid-punctate, with 5—9 pairs arching fine sec. n. Flowers pretty, white, ·5—·75″ diameter with broad roundish spreading petals and exserted stamens. Fruit 6″ by 1·5″ terete, of perfectly united carpels.

Fls. *April-May* (one flowering specimen also labelled *November*). Fr. *Nov.—Jany.*

Balaghat; Deori, near Sheonath river (Raj-Nandgaon); S. Chanda 'not uncommon,' *Donald*

Nerium odorum, *Soland.* Kaner, *H.*

The Oleander, with whorled narrow leaves, 4–6" long and beautiful rose or white flowers, is extensively cultivated.

Anodendron paniculatum, *A. DC.*

A large climber, juice scarcely milky, with stout green stems and large oblong shining strongly pinnate-nerved leaves which attain 10 by 3·25", pubescent or puberulous beneath with many strong oblique sec. nerves looping within the margin. Uppermost leaves narrow-oblong 4—5" by 1·5". Small, pale yellow salver-shaped flowers in very lax slightly branched axillary and terminal brachiate panicles. Follicles 5—6" long and ·6" diameter at the base, tapering.

Fls. *March-April.*

Sironcha Range, rare.

Ichnocarpus frutescens, *Br.* Dudhi, Dhimar Bel, *H.*; Dudhbel, *Mar.* (name applied to most milky-juiced climbers).

A large rambling or climbing shrub, woody below, with rusty tomentose branchlets, elliptic or broadly-oblong glabrous leaves 1·5—4" long, pale beneath, and narrow panicles of small white flowers ·3" diameter with narrow twisted bearded lobes. Panicles usually leafy with short branches. Follicles 3—6" linear divaricate only ·1" broad.

Fls. *Sept.—Dec.* Fr. *Jany.—March.*

Leaves turn brown or reddish in February before falling.

The plant s sometimes confused with *Hemidesmus*. Frequent in hedges, etc.

Panchera (Bal.); S. Chanda; 'common,' *Donald*; N. Chanda; probably in all divisions.

It is used for tying.

XLIV.—ASCLEPIADACEÆ.

Hemidesmus indicus, *Br.* Anandmal, *H.*

A slender twining shrub with rather distant opposite pairs of leaves 1—4" long by ·3—1·5" broad, most variable in shape, always

apiculate, very frequently with a white central streak above and pale beneath; base rounded, sec. n., few.

The small flowers are clustered in the axils of the leaves and are green outside, purple within. Calyx spreading in fruit and then ·25″ diameter. Follicles glabrous divaricate 4—5″ by ·2″.

Fls. *Aug.-Sept.* Fr. *Oct.—Dec.* Evergreen.

Very frequent, both in forests and hedges in all divisions. Used in Hindu medicine to relieve fever, also for skin-diseases.

Var. pubescens. Branches and leaves pubescent.

Nagpur, Raipur, B. N. Chanda.

Var. reflexus. Follicles up to 7″ strongly reflexed, seeds ·25″ long. L. up to 4″ by 2″ pubescent.

Sangarhi (Bh.); Dokal (Rai.).

Cryptolepis Buchanani, *Roem.* Bokharia, *Gond.;* Kala Bel, *H.* (f. Donald.)

A large twining shrub with glabrous, oblong or elliptic entire leaves 3·5—4·5″, shining above and white glaucous beneath, and axillary 2-chotomous cymes of pale yellow flowers. Corolla tube ·1″, lobes ·3″. Follicles 2·5—4″ long by ·5—·75″ diameter.

Fls. *May-June.* Fr. *Dec.—Feby.* Evergreen.

Common in valleys in all divisions.

Calotropis gigantea, *R. Br.* Madar, *H.;* Akan, Ak., Rui, *Mar.;* Jelleda, *Tel.*

A stout white tomentose shrub (occasionally a small tree with trunk 12″ girth), with large more or less obovate-oblong leaves 4—8″ long, narrowed to a cordate, often amplexicaul base and handsome reddish light purple or lilac flowers 1—1·5″ diameter with spreading petals.

Follicles 3″ by 1·5″ recurved obtuse.

Fls. *Dec. July.* Fr. *Feby.—June.* Evergreen.

In open waste ground, general.

Calotropis procera, *R. Br.* Vern. names as in the last.

A shrub 3—4 feet, closely resembling the last. Leaves usually suddenly often sharply acute or sub-mucronate, old, glabrous

beneath. Flowers with *erect* petals which are white with a deep purple blotch within.

Fls. chiefly *Dec.—Feby.*

Cryptostegia grandiflora, *Br.*

A scrambling glabrous shrub with elliptic obtuse coriaceous shining leaves 3—4″ long and large, light purple funnel-shaped flowers 1·5—2″ diameter.

Very commonly cultivated in gardens and semi-wild about Nagpur.

Pergularia extensa, *N. E. Br.* (Syn. Daemia extensa *Br.* in F. B. I. and 'Forest trees.'). Uteran, *Mar.*

A slender sub-hispidly hairy or glabrate fœtid climber with membranous orbicular or broadly ovate, deeply cordate acuminate leaves 2—4″ long and broad, and green, or yellowish-green, and red salver-shaped flowers ·6—·7″ diameter, in long-stalked corymbose drooping panicles. Follicles 1 5 3″ lanceolate with long soft spines.

Fls. *Oct. Dec.* Fr *Dec.-Jany.*

Very common in village hedges. Nagpur, Bhandara, Balaghat and found in all divisions.

Note.—This plant belongs to the genus Pergularia of Linnaeus, *not* the genus Pergularia as defined in the F. B I, *vide* Coville in "The Useful Plants of the Island of Guam," published, 1905, in the U. S. Nat. Herb. IX, 364, and N. N. E. Brown in Kew *Bulletin* 1907, p. 323.

Holostemma Rheedei, *Wall.* Jaganthi Jhuti, *Mar.*

A twining glabrous or puberulous shrub with obtusely triangular ovate or oblong-ovate cordate leaves 3—6″ long, the large basal lobes often incurved. Flowers, 1—1 5 diameter, purple and white with cup-shaped corona. Follicles short thick curved.

Fls. *July—Sept.* Fr. *January.*

Nagpur. 'Eaten as a vegetable' (*Graham.*)

Marsdenia Hamiltonii, *Wight.*

Sub-erect when flowering, ultimately climbing, from a very stout perennial rootstock. L. 1·5—2·75′ at the time of flowering,

ovate or broadly oblong shortly, sometimes obtusely, acuminate mostly with cordate base, puberulous above, furfuraceously pubescent on the nerves beneath (nearly glabrous in the type). Sec. nerves 4—5 each side, nervules strong and raised beneath. Cymes corymbose bifurcate dense on very short peduncles, pubescent. Flowers campanulate ·15″ diameter, with densely villous throat. Stamens with very slender subulate appendage or back of anther.

Fls. *April-May.*

Topla (Bal.); Mandla-Bilaspur boundary line (Bil.).

The fruit is not known and should be looked for. It is said to be eaten.

Marsdenia tenacissima, *W. & A.* Marwat, *Mar.;* Chinhaur, *Gond.*

A stout, very tough-stemmed twiner with very milky juice, stems attaining ·5″ diameter and persistently pubescent L. velvety to touch both sides, tomentose when young and persistently on the nerves, broadly ovate, suddenly shortly acuminate or cuspidate, adult 4—7″ by 3—5″, with deeply cordate or lobed base. Petiole 1·5—3″. Flowers green, ·3″ diameter sub-campanulate with spreading lobes, corymbose, in much branched cymes which are sessile or very shortly pedunculate. Follicles 5″ long by 1·25″ thick (thickest part about one-third way up) obtuse, grooved on one side, especially above towards a short thick beak, velvety, very milky.

Fls. *April—June.* Fr. *Nov.—Feby.*

Not very common. Baloda-Dhamtari sandstones (Rai.); Haveli Range (N. Ch.)?

Yields an excellent fibre.

Marsdenia volubilis, *Cooke.* (*S. yn.* Dregea volubilis, *Benth.* in F. B. I. and 'Forest trees.') Bandegurji, *Tel.;* Ikdodi, *Mar.*

A stout twiner with stems attaining 1″ diameter, somewhat corky reticulate bark and pale, very lenticellate twigs, ovate or broadly-ovate leaves, more or less acuminate, usually hoary with a

fine curled pubescence, 2·5—6″ or 7″ long, usually with a number of small subulate glands at the base of mid-rib above, base rounded rarely cordate, sometimes acute and unequal. Flowers green rotate, or sub-campanulate when old, ·5—·6″ diameter in dense drooping usually branched umbels. Peduncles 1—3″ becoming woody in fruit. Pedicels ·5—1″. Petals broadly oblong or ovate obtuse. Follicles 3—4″ by 1—1·5″ diameter, single or paired on the long woody peduncles and pedicels.

Fls. *May-June*. Fr. *Dec.—Feby*.

Common in valleys, Bazargaon block, Magardokra forest and Girur (Nagpur Wardha); N. & S. Chanda; and probably in all divisions.

Its juice is milky, but I suspect that this somewhat depends upon the season, specimens collected in December had sub-watery juice. The rind of the fruit is used as a vegetable.

Telosma pallida, *Craib.* (in contrib. to Flora of Siam.) Syn. Pergularia pallida, *W. & A.* in F. B. I., Indian Trees, etc Marwat, Ikdori, *Mar.*

A strong twiner with *sub-watery* juice, stems somewhat furrowed and pustular, glabrous when old, ovate or ovate-cordate shortly cuspidate leaves 2—5″ long, on slender petioles ·75—2″ long. Old usually deeply cordate with nerves beneath shortly pubescent, but otherwise glabrous. Flowers, greenish or yellowish-white ·75—1″ diameter with distinct tube, in axillary umbelliform cymes on very short peduncles. Follicles usually solitary, very smooth with thin shell 3—4″ long, thickest about the base, tapering rather suddenly on woody pedicels ·3—·5″ and peduncles never exceeding 1″.

Fls. *May*. Fr. *Nov.—Jany*. Renews leaves at the time of flowering.

I have no specimens from the Southern Circle, but it occurs in Western Bengal, Canara, Mysore, U. P., and Bombay, and therefore likely to be found.

. S. Chanda (f. Donald).

(For alteration of the generic name of this plant see loc. cit. under *Pergularia extensa* .

Leptadenia reticulata, *W. & A.* Bhui dodi, *Mar.*

A twining shrub with corky bark and slender branches. Young leaves oblong-lanceolate hoary, older ovate 2—3", thinly pubescent or glabrous. Flowers ·2" diameter, green or yellow, rotate, pubescent in umbels ·75—1" across. Follicles 2·5—3".

Fls. *May—July.* Fr *Feby.*

Nagpur.

Graham says that the plant is used for reducing copper.

XLV.—LOGANIACEÆ.

Strychnos Nux-Vomica, *L.* Kuchale, *H.;* Bibtamupti Chetu, *Tel.*

A m.s. or large handsome tree with ovate or sub-orbicular shining leaves 2—4" long with three strong and two weaker nerves from near the base and petiole ·3—·5" long. Flowers, white tubular, with short lobes, in short peduncled cymes mostly at the ends of the short branchlets. Fruit globose, bright orange 1—2" diameter. The discoid satiny seeds are surrounded by a white intensely bitter pulp.

Fls. *March-April.* Fr. *Dec.-Jany.* Evergreen.

Laun Range on quartzite plateau (Rai.); Tumnur and Marigudam Forests (S. Chanda); Ahiri. Chiefly on deep alluvial soils.

A well-known source of strychnine

Strychnos potatorum, *L. f.* Nirmali, *H.;* Kahur, Kahi, *Mar.;* Chilla, *Tel.* The Clearing Nut.

A small branched tree with blackish cracked bark, elliptic or ovate leaves 1·5—3" long, nervation often much as in the last (sometimes sub-penninerved), but easily recognised by the petiole being under ·2". Flowers, white with the corolla tube only ·12—·17" long in numerous lateral cymes. Fruit globose ·5—·7" with firm pericarp, thin pulp and often only one large thickly lenticular seed ·4—·5".

Fls. *May.* Fr. *Oct.—Feby.* Evergreen.

Common in Nag. War., Bhandara and N. Chanda, also found in S. Chanda, Bal., Rai., and rarely in Bilaspur,

The seeds (Kawi) rubbed in water to a pulp are used for sore eyes. They are also used for clearing muddy water.

XLVI.—GENTIANACEÆ.

Swertia angustifolia, *Ham.* Var. pulchella, *Burkill.* Chiretta, *H.*; Chirainta, *Baiga.*

A pretty herb 2—3 feet high, with weak 4-angled stems, sessile lanceolate, 3-nerved leaves 2·5—3·5" long and numerous flowers, both solitary axillary and in terminal cymes, the whole forming long leafy panicles. The fls. are white with lilac veins and blue dots, petals 4, ·3" long with the gland at the base covered by a large scale.

Fls. Nov.—Jany.

Grassy glades. Dhamtari, Singpur and Sihoa (Raipur); Paraswara Forest (Bal.).

An infusion of this plant is used for fever and as a stomachic.

Enicostema littorale, *Blume.* Nai, *Mar.*

A pale glaucous herb with sessile-oblong or linear-oblong leaves and axillary clusters of small white flowers in sessile clusters. Corolla tubular funnel-shaped with five lobes.

Fls. r.s.

Common on cotton soil and trap rock. Said to be a cure for snake-bite and scorpion sting. Mr. Rogers also sent a specimen from Berar, where it is similarly used. It was tried on myself for scorpion sting without effect.

XLVII.—BORAGINACEÆ.

Cordia Myxa, *L.* Lasura, *H.*; Bokar, *Mar.*; Virki, *Gond*; Irki, *Tel.*; Shelu, *Mar.*

A small or m. s. crooked tree with often drooping branches, brown bark with shallow wrinkles and furrows. Innovations densely fulvous, somewhat stellately pubescent and with longer hairs. L. 3—6-nerved at the base, orbicular elliptic, oblong or typically obovate, with cuneate base 2—5·5", often repand-dentate, old glabrous except in the axils of the nerves beneath smooth

above to the naked eye, but under the lens marked with small white dots, Sec. n. about 4 pairs distinct, tertiares scalariform, but not quite straight, very reticulate between. Petiole ·75—1·2″ usually rather slender. Flowers in numerous irregular or sub-corymbose cymes 2—4″ diameter. Flowers white. Fruit conical when young, old ·5—·75″ shining yellow with very viscous pulp, one-seeded, seated on the enlarged saucer-shaped calyx which is ·5—·75″ diameter.

Fls. *March-April*. Fr. *June—August*.

Chiefly along nalas, in all divisions, but not very common.

The wood does not appear to be much used except as a fuel.

The fruit is eaten.

[*Note.*—I have described the typical Cordia Myxa above, as there is much confusion in the species. Brandis (*Indian Trees*, p. 478) states that the cystolith cells are not conspicuous on the upper surface of the leaves. This is true of the type which has, however, scattered and grouped discs as well as the white dots.]

Var.-(C. obliqua of F. B. I., not of Willdenow ?)

L. puberulous beneath entire not cordate with cystolith cells conspicuous as raised discs on the upper surface. (*Vide* Brandis' *Indian Trees*, p. 478.) Cymes short dichotomous. Calyx tubular campanulate, regularly lobed.

Sijhora (Bal.) on plateau.

Cordia latifolia, *Roxb.* Bara Lasura, *H*

Leaves large attaining 8 by 5·5″ ovate with rounded or subcordate base puberulous between the straight prominent tertiary nerves beneath. Discs present on the upper surface of leaves but not distinctly raised.

Sonawani Hills (Bal.), Panchgaon Block (S. Ch.) ?—*Donald*.

[*Note.*—This is called Cordia obliqua? in Flora of Chota Nagpur, but I have since seen a type leaf of Willdenow's *Cordia obliqua*, and it hardly seems the same. The tree is, however, quite different from ordinary C. Myxa. Donald remarked that this plant looks like a glabrous form of Cordia Macleodii. Willdenow describes C. obliqua as with leaves subrotund-cordate and oblique, differing from Myxa by its quite entire leaves never repand-dentate by the calyx not being striate. But Cordia Myxa is wrongly described as with striate calyx. I have seen a type leaf of Willdenow's C. obliqua. It is shallowly cordate, 5-nerved at base with 3 sec. n. above base, tertiary nerves as in Myxa, and nervules very reticulate raised beneath, undersurface uniformly thinly pubescent.

Cordia obliqua, with its so called variety Wallichii, at Kew, appears to me a heterogeneous assemblage of forms and it even contains a nearly typical form of C. Myxa.]

Cordia Wallichii, *G. Don.*

"A middle sized tree, leaves entire or nearly so, densely and softly tomentose beneath with stellate hairs, otherwise similar to C. Myxa."—*Brandis*

Not common. Mircul (S. Chanda).—*Donald.*

[*Note*—I have not seen Mr Donald's specimen If it only differs as stated, it would appear to be a mere variety of C Myxa, but I think it may be also distinguished by its very long peduncled cymes and often broadly ovate sub-cordate leaves It is probably Beddome's *Cordia Wallichii* (Fl Sylv. t. 245) and Wight's *Cordia obliqua* (Ic t. 1378), but Don's *C Wallichii* = Wallich's *Cordia tomentosa* No. 897, a Nepalese plant and doubtfully the same.]

The whole group requires further study in the field, specimens being collected from the same individuals in different stages of growth.

Cordia Macleodii, *Hook. f.* and *Thom.* Daigan, *H.*; Daiwas, *Mar.*; Botku, *Tel.*

A small or m. s. tree with light grey bark. Blaze pale turning brown. Twigs, leaves beneath, and inflorescence covered with a white felted or tawny tomentum. L. broadly ovate, entire, often deeply cordate obtuse or very shortly acuminate 4—8" or even 10" long. Petioles 1·5—3". Discs on the upper surface close numerous. Flowers white in dense extra-axillary or leaf opposed corymbs. Fruit very acuminate when young, globose apiculate ·75" and yellowish somewhat tomentose when ripe.

Fls. *March-April.* Fr. *May-June.* Nearly evergreen.

Frequent in all divisions. Wood used for implements It is "light brown, beautifully even-grained and very hard."—*Gamble.*

Ehretia lævis, *Roxb.* Datranga, *H.*; Dokke, *Gond.*; Reda palacante, *Tel.*

A small or m. s. tree with pale grey or white bark. Blaze white with small brown streaks, turning deep brown. L. ovate, ell. or ell.-oblong rarely obovate, entire usually with small tufts of hair in the axils of the 5—6 pairs sec. n. beneath, base usually cuneate on the petiole. Flowers white sessile ·3—·4" diameter in dichotomous scorpioid cymes 2—4" diameter. Fruit, a sub-globose black, drupe with 1—4 one-seeded pyrenes.

Fls *Feby.-March.* Fr. *March-April.* Deciduous *Feby.* or *March.*

Frequent, chiefly near river-beds on gravel, *e.g.*, Bawanthari River, N. W. and Bhandara; S. Chanda, common; Bal. Wood not used. Leaves used for fodder. Fruit eaten.

Ehretia microphylla, *Lamk.* (Syn. Ehretia buxifolia, *Roxb.*)

A twiggy shrub, 3—5 feet with drooping minutely strigose branches. L. solitary and fascicled on abbreviated shoots ·25—1·25" long, very dark green shining and hispidulous above, pale beneath, obovate or obovate-lanceolate narrowed into a very short hispid ·05" petiole apex rounded usually 3—5-toothed. Flowers one-sexual white ·25" diameter on slender terminal peduncles ·02—·3" long which are sometimes 2-flowered. Fruit, globose ·2" diameter with deeply 2-fid style, drupaceous, with 4, one-seeded cells.

Fls. *Oct.* Fr. *Nov.*

In undergrowth; dry forests of the Umrer Range (Bori Majra); N. Wardha.

Rhabdia lycioides, *Mart.*

A shrub 2—4 feet with very tough erect, or prostrate and rooting branches, linear or oblong-oblanceolate leaves ·5—1·25" long and small pink flowers ·25—·5" diameter, usually 2—3 at the ends of the short lateral branchlets. Drupe orange-red.

Fls. *Oct.—Jany.* Fr. *Dec.—Feby.* Evergreen.

In rocky river-beds in all divisions

XLVIII.—CONVOLVULACEÆ.

Erycibe paniculata, *Roxb.* Kaka beli, *Gond.*; Kati tige, *Tel.*

A large climbing shrub with conical protuberances on the trunk, rusty tomentose shoots, entire oblong, rarely oblanceolate or obovate abruptly acuminate leaves about 5" by 1·5" and terminal rusty cymose panicles of yellowish-white flowers ·5" diameter with crisped petals. Berry black, ·6" long, with dark-purple flesh, seated on the spreading persistent calyx.

Fls. *April—June*. Fr. ripens following *May*. Evergreen.

Valleys, near nalas. Lormi and Pantora forests (Bil.); Mukri, Garangi (S. Ch.); Maramsllli (Rai).

Var. Wightiana. L. ell. cuneately acuminate at both ends or lanceolate. Flowers, white, sweet-scented.

"South Chanda. Fls. *November*."—*Donald.*

The fruit is eaten.

Rivea hypocrateriformis, *Chois.*

A climber with silky stems, orbicular-cordate cuspidate leaves 2—3·5″ diameter, white with adpressed silky hairs beneath, and long-tubed white flowers, 2″ diameter. Capsule sub-globose apiculate ·6″ diameter, seated on the 1″ diameter calyx, breaks up transversely a little above the base.

Fls. *Aug.-Sept.* Fr. *Nov.-Dec.*

Common, especially in scrub jungles.

Argyreia sericea, *Dalz.*

A large twiner with roughly hairy or villose and strigose stems and ovate cordate leaves which are beautifully silvery silk beneath and hairy above, especially when young. Petiole 1·5—2″. Flowers pink tubular funnel-shaped 1·5″ long (—2·5″ F.B.I.) in capitate few-flowered cymes with an involucre of leafy ovate to ovate-lanceolate bracts and bracteoles and peduncles 1·5—3″ long. Berry ·25—·5″ diameter yellow.

Fls. *July—Sept.* Fr. *Oct.-Nov.*

Frequent. Nagpur-Wardha; N. & S. Chanda.

Lettsomia setosa, *Roxb.* Bagchaur, *Gond;* Masbel, Baswel, *Mar.*

A strong twiner with milky juice, strigose stems up to ·25″ diameter ovate or narrowly-ovate, cordate leaves up to 7″ by 6″ with shortly cuspidate or somewhat acuminate tip, thinly strigose beneath, squamate or microscopically pitted (after fall of the scales) above. Petiole 2—6″. Flowers in corymbose cymes, pale pink-purple about 1·5″ long and broad, somewhat curved, with declinate stamens. Bracts orbicular. Peduncles 3—7″. Berry ovoid red.

Fls. *Nov. Dec.* Fr. *Dec.—Feby.*

Kolsa (N. Ch.); Ghatula, etc. (Raipur) frequent; Elgur, etc. (S. Ch.); probably in all divisions.

Ipomæa Turpethum, *Br.* (Syn. Operculina Turpethum, *Manso.*)

An extensive climber with 3 -4 narrowly-winged stems, ovate cordate, acuminate or acute, glabrous or pubescent leaves 3—8" long and many 2—5-fld. cymes of white flowers 1 5—2" diameter. Sepals ell.-oblong at first, ultimately calyx, inflated with orbicular concave sepals 1" long in fruit. Endocarp of fruit quite transparent

Fls. *Oct—Jany.* Fr. *Dec March.*

Frequent Bhandara, N. Chanda; S. Chanda: Bhainsajhar (Bil)

Ipomaea muricata, *Jacq.*

A twiner with tough muricate stems, cordate-ovate glabrous leaves and rose purple flowers 2—2·5" diameter. The peduncle is much swollen above in fruit.

Fls. *Sept.—Nov.* Fr. *Dec.-Jany.*

Elgur (South Chanda).

Cuscuta reflexa, *Roxb.* Amarbel, *H.*, is a parasitic herb consisting of a number of yellow fleshy threads attaching itself by means of 'haustoria' to its host plant—usually species of Zizyphus and Babul. It is liable to be confused with another plant of similar habit, *Cassytha filiformis*, from which it may be distinguished by its yellow green colour (the Cassytha is blue-green) and the convolvulus-like structure of the small white flowers

Found in all divisions except in South Chanda.

There are numerous other unimportant climbers belonging to this family. Ipomæa Batatas, the sweet potato, is cultivated in the sandy beds of the rivers.

XLIX—BIGNONIACEÆ

All the following have compressed seeds with membranous wings.

Millingtonia hortensis, *L.f.* The Indian Cork Tree.

A tall somewhat shallowly rooted tree, much grown in avenues and gardens, with pretty bi-pinnate leaves and panicles of pendant white long-tubed fragrant flowers.

Fls. *October—December.*

Oroxylum indicum, *Vent.* Tantu, *Mar.;* Dudilam, *Tel.;* Jai Mangal, *Gond.*

A small tree with soft thin bark and pale yellowish green blaze, few branches, and terminal clusters of very large ternately 2—3 pinnate leaves, 2–4 ft. long and broad, leaflets about 5′ by 3 acuminate. Flowers large fleshy-dark-purple in terminal stout racemes. The tree is easily recognised when leafless by the large leaf scars and immense flat capsules 1—3 feet. long.

Fl. *July-August.* Fr. *Dec.—March.* Deciduous *Dec.—June.*

Moist and rocky valleys. Kara (Bal.); Sitanadi, Sihoa forests (Rai.); S. Ch.; nowhere common.

Believed not to be used in the Southern Circle but Witt says the "bark and fruit used for tanning" in Berar.

Dolichandrone falcata, *Seem.* Merdsingh, Mersingh, *Mar.;* Udda, *Tel.*

A small or m. s. hoary pubescent tree with grey bark exfoliating in irregular scales. L. pinnate or sub-2-pinnate, the secondary rachis nearly obsolete (so that the leaflets appear to start from a node of the main rachis. The pedicel of the third leaflet is, however, longer) rachis 2—5″ with usually 5—7 or, in 2-pinnate leaves, up to 13 leaflets. Leaflets ·5—2·5″ sometimes retuse or shortly cuspidate. Petiolule (except in terminal leaflets) 0—·1″. Flowers pretty, white, 2″ diameter with tube 1·5 long, dilated above, in short few fld. corymbose racemes, petals crisped. Pod 12—18″ long, curved compressed.

Fls. *April—June* (also occasionally in *November*). Common in the western divisions, rare in the Sal forests. Frequent on cotton soil. Beddome says that the wood is used for building and agricultural purposes.

Heterophragma Roxburghii, *DC.* Palang, *H.;* Bondua Mara, *Gond.;* Warsi, *Mar.;* Bondgu, *Tel.*

A large tree attaining 7—8 feet girth with very stout twigs marked with opp. leaf scars. Bark very rugose, thick with brown and yellow blaze, rather soft. L. pinnate 10 18" with 5—9 ell. or oblong (or terminal ovate) leaflets 2·5—8" mature glabrous, usually shortly suddenly acuminate or point obtuse, rarely acuminate, base on the lower side decurrent on the petiole, margin crenate serrate or sub-entire, sec n. 3—5. Petiolules 0—·2" Flowers, large 1 5—2" white or pinkish, in close terminal tomentose panicles 6" long. Calyx ·75" mostly 2-lipped, sometimes lips lobed. Lobes of the corolla crisped pink. Capsule purple-brown 8—12", stout straight oblong 4-celled

Fls. *Dec.-Jany.* Fr. *April-May.*

Valleys. Frequent in South Chanda forests, especially Allapalli and Markhanda ranges near the hills; Aikala (N. Chanda).

Stereospermum chelonoides, *DC.* Chota Padar, *H;* Lahan Palang or Parad, *Mar;* Pandri, Pindri, *Gond*

A tree, rarely large in the C P, with nearly smooth grey bark. Blaze thick pale, yellow zoned, with hard and soft layers Leaves clustered towards the ends of the twigs 6 15" long. Leaflets 7—11, 3—5" elliptic caudate, glabrous, entire or somewhat serrate, sec. n. 4—10 pairs. Petiolules 3—·5". Flowers fragrant in lax drooping terminal panicles with articulate slender branches Calyx ·25" purple glabrous. Corolla 75" yellow and purple with purple veins, villous inside anteriorly. Pod 9 20", somewhat curved or spiral, 4-angled or sub-terete. Seeds angular in, and of the shape of, the notches in the thick septum, over 1" with the wings.

Fls. *April—June.* Fr. *Oct.—Feby.* Deciduous at the time of flowering.

Not uncommon in the valleys; Bhandara; Khairagarh; Balaghat, Nagpur (Pench and Arvi forests); N. and S. Chanda.

[*Note.*—The description of the inflorescence above is that of normal S. chelonoides, but all the inflorescences collected by me are pubescent and glandular with flowers up to 1", calyx 3". These closely resemble, and may possibly be, the panicles of S suaveolence, but I am inclined to think that the small tree put down when in leaf as S. chelonoides in the C P., is often a third species the inflorescence of which whenever collected is put down as that of a small-flowered D. suaveolens. The point requires looking into. In any case the following variety occurs.]

Var. angustifolium.

Leaflets 2—7·5" narrowly elliptic to oblanceolate oblong acute or acuminate, old coriaceous and somewhat pubescent beneath sec. n. 6—10 pairs.

Nagpur and Balaghat.

Not much used.

Stereospermum suaveolens, *DC.* Padar, *H.*; Parad, Paral, *Mar.*; Pandri, *Gond.*; Pedda Kalaguri, Pedda Kalagodu, *Tel.*

A middle-sized or large tree with the young parts tomentose large odd-pinnate pubescent leaves 12—18" long with 5—11 leaflets which are broadly elliptic or oblong, usually shortly suddenly acuminate 3—7" long by 2—5·3" sec. n. 5—8 pairs. Petiolule ·05—·25". Flowers fragrant in pyramidal viscidly hairy panicles with 2—3 chotomous branches. Calyx ·3—·5" hairy. Corolla 1·2—1 5" dull purple, yellow within. Filaments with a tuft of hair at the base. Pod 18" by ·7", often spiral Seeds much as in the last.

Fls *March—May.* Fr. *Sept.—April.* Deciduous at the time of flowering or flowers with young leaves. Ripe seed was found together with flowers at the top of the Lodu Burra (Bal.) in *April.*

In all divisions in the valleys, plains and plateaux, but not very common.

The wood is not much sought after, though Gamble says that it is durable, easy to work and good for building, but the amount of heartwood is small. It had the reputation in Bengal of being the most difficult wood to split. A good fire-resister. The leaves of the seedlings are simple, harsh and serrate.

(The petiolule is said usually not to attain ·1", but this is an error.)

Stereospermum xylocarpum, *Wight.* Katori, *Gond.*; Katora, *Bhumia*; Son padri, *Baiga*; Gohadan, *Mar.*; Wahawaria, *Maria.*; Warawaili, *Tel.*

A large tree attaining 8 feet girth with thick light grey bark rather smooth and flaky, moderately thick light brown blaze darkening on exposure. Leaves very large 2—3 feet long, 2—3-pinnate, with rather pale or silvery appearance beneath.

Leaflets elliptic to ovate, shortly acuminate, with a usually rounded base, 2—6" long entire or coarsely-serrate. Fls. sweet-scented, large white or pinkish 1·5—2·5" in stout panicles with the pedicels sub-capitately corymbose, upper parts of the panicles and bracts are tomentose. Corolla lobes subequal quadrate with crisped sub-lobed margins. Pod up to 3 feet long, woody tubercled, central septum ·5" broad. Seeds 1·2" long with the wings.

Fls. *April-May*. Fr. up to the following *April*.

Not very common. Mixed forest of Sal in the Lormi forests and valleys of Pantora, frequent (Bil.), ghats of Balaghat, common in the valleys; Umarjhari (Bh.); South Chanda, frequent, chiefly among the hills.

The wood is "good and handsome," (*Gamble*), but it does not appear to be sold in the Southern Circle.

CREOSOTING OF SLEEPERS.

We print copy of two letters addressed to the Conservator of Forests, Punjab, on the experimental creosoting of four species of conifer by the Millars' Timber and Trading Co., Ld.

The amounts of oil taken up do not appear very promising, but it should be borne in mind that only two sleepers of each of the four species were tested. The results of tests made on so small a scale should be received with caution, this has been proved by experience at the Research Institute.

Copy of a letter No. G.-2098, dated 24th November 1911, *from the Local Director, Millars' Timber and Trading Co., Ld., to the Conservator of Forests, Punjab.*

We beg to enclose herewith copy of report made by our Engineer who attended at the Creosoting of the Sleepers kindly supplied by you, which no doubt will be of considerable interest.

A copy of the report has also been sent to the Railway Board, with a request to distribute the sleepers amongst the Railways.

The sleepers have been shipped to Bombay and are expected shortly to arrive.

We shall be glad to have your opinion on the report.

OUTER TEMPLE,
222, Strand, London, W. C.,
22nd September 1911.

J. L. V. MILLETT, ESQ.
THE PURFLEET WHARF & SAW MILLS, LD.,
Pinners Hall, London, E. C.

DEAR SIR,

At your request I attended on the 7th instant at the works of Messrs. Alex. Bruce and Co., Grays, Essex, Railway Sleeper and Telegraph Pole Contractors and Creosoters, and there witnessed the process of creosoting a consignment of railway sleepers composed as follows :—

1	lot	of	25	marked	"Spruce,"
1	,,	,,	24	,,	"Silver pine,"
1	,,	,,	25	,,	"Blue pine,"
1	,,	,,	24	,,	"Chil pine,"

the dimensions of these sleepers varied from

10′ 4″	to	10′ 6′	long.
10″	,,	$10\frac{3}{4}$″	wide
5″	,,	$5\frac{3}{8}$″	thick.

All the sleepers were in very dry condition.

From each of the above lots two sleepers were withdrawn as requested, and were left untreated.

London Gas Works Creosote was employed to comply with the following specification requirements :—

Specific gravity, 1·070 to 1·076.
75 per cent. to distill over at 610° F.
Tar acids, 8—10 per cent.

The method of treatment at these works was as follows :—

The sleepers were packed on bogies, taking up to 47 sleepers per load, and run into the treating cylinder. The cylinder was filled with creosote and pumped to a maximum pressure of 95 lbs. per square inch. The pressure diminished from time to time as

absorption proceeded, but was followed up and maintained at the maximum by the charging pump.

The temperature of the creosote was 75° F., and no steam heating was applied to the creosote tanks or to the treating chamber.

The sleepers were taken out after two hours' treatment and two from each lot, measured and weighed before treatment, were re-weighed. The average absorption per cubic foot was as set out in the following table below :—

Sleepers marked	Untreated Wt. Cub. ft. lbs.	Creosote absorption, 2 hours' treatment.	Lbs. per c. ft., 6 hours' treatment.
Spruce	30·7	1·58	2·5
Silver fir	33·3	2·54	3·15
Blue pine ...	34·5	1·01	1·51
Chil pine ...	47·2	7·32	8·47

From this table it will be observed that with the exception of the "Chil pine" the degree of absorption or impregnation fell very short of the stipulated 10 lbs. per cubic foot

"Spruce" and "Chil pine" sleepers selected at random were cut at 6 inches at the centre, to observe the degree of impregnation. In the case of the former the whole area was impregnated from 2 to 3 inches from the end, but rapidly lessened until at 6 inches only a very small area showed traces of absorption except that by surface absorption. At the centre only the surface showed signs of absorption.

In the case of "Chil pine" the whole area was impregnated at 6 inches and the centre also showed very good absorption.

In the absence of specific instructions I thought it desirable to test the effect of more prolonged treatment, and accordingly on the 12th and 14th instants an additional four hours' treatment was given to the specially weighted and marked sleepers.

Before re-treating, the sleepers having been stored flat, *i.e.*, horizontally placed, were weighed and found to have the same

weight as ascertained after two hours' treatment. On the completion of six hours' total treatment the total absorption was as given in the table.

From this it will be seen that the quantities taken up by the "Spruce," "Silver pine," and "Blue pine" sleepers remain small and very much below the stipulated 10 lbs. per cubic foot. When cut at 6 inches and 18 inches and hacked to observe penetration at mid-length, the impregnation was found to be unsatisfactory and incomplete.

The "Chil pine," however, showed good absorption, with the whole area impregnated at mid-length.

It was noted that most of the sleepers were cut from trees of large size and not from trees cut to two sleepers as is customary. A large proportion of the sleeper section was therefore sapwood as distinguished from heartwood and impregnation was more complete and the absorption rate higher than is to be expected when a larger part of the area of the section is composed of heartwood.

For your information I may add that Mr. H A. Williams, Works Manager to Messrs. Alex. Bruce and Company, who also witnessed the treatment of these sleepers, finds that by this method of creosoting as described herein and as regularly adopted in the Works, average absorption at the rate of 10 to 16 lbs. per cubic foot is obtained with the "Red fir" or "Baltic red wood" of the kind commonly employed for sleepers This degree of absorption occurs in from one to two hours, according to the condition of the timber. This rate of absorption may be usefully compared with that ascertained and shown in the table included herein for the four kinds of timber composing your consignment of sleepers.

I conclude that it is commercially practicable to treat the "Chil pine," but that the other three kinds of timber cannot be effectively creosoted.

I am,
Yours faithfully,
(Sd.) W WORBY,
Beaumont.

Copy of a letter No. G/557, dated the 27th February 1914, from the Local Director, Millars' Timber and Trading Co., Ld., Bombay, to the Conservator of Forests, Punjab.

We beg to enclose herewith copy of the report which the Engineer-in-Chief has supplied us for creosoted sleepers of Indian timbers, and trust it may be of interest to you.

INSPECTION OF CREOSOTED PINE SLEEPERS ON 11TH DECEMBER 1913.

Sleepers. Kind of wood	Size and number of sleepers laid down.	Date of laying down sleepers.	Exact locality in distance from nearest Railway station, mile No. and No. of telegraph post, but where the sleepers are laid down.	Process by which the sleepers have been treated	Date and record of Railway Officer's inspection with designation of officer.	Remarks.
Creosoted Pine sleepers						
(a) 6 Chil Pine	24 sleepers with bearing plates.	22-3-12	Mile 261 8-9 within Down Distant Signal of Rampur Station.	Creosoted by Millars' Timber Karri and Jarrah Co	Examined on 11th December 1913 by Mr E. G. Rodwell, Executive Engineer.	(a) Good.
(b) 6 Spruce						(b) Has a tendency to crack and wrap
(c) 6 Blue pine						(c) 1. Cracked and warped. 2. Warped 3 Good
(d) 6 Silver pine						(d) Good. None of the above has been touched by white-ants.

EUCALYPTUS EXPERIMENTS IN THE SIMLA HILLS

The experiments were started in 1906 at the instance of the Government of India, with a view to facilitate the fuel supply of Simla. It had been pointed out that wood fuel at Simla cost about Rs. 20 per ton at the depôts and consisted of Oak with a certain proportion of inferior wood in rough billets difficult to split or to ignite. At Ootacamund the price of wood in more suitable sizes was only Rs 3 per ton delivered, this cheap rate being due solely to the substitution of quick-growing exotics for the slow indigenous trees. Although the climate of Simla is very different to that of Ootacamund, it was considered reasonable to expect that from a genus consisting of some 150 species something suitable could be selected wherewith to clothe the bare hills and afford a cheap fuel for the inhabitants of Simla.

A start was made with *E. Globulus* and *E. rostrata*, and seed of each species was sown in nurseries in various parts of Simla at the beginning of April 1906. The seed of *E. Globulus* germinated very well, that of *E. rostrata* sparingly. Towards the end of May, the seedlings which were 3 inches in height were pricked out in the nurseries, and at the end of July, when 6 inches high, were planted in the open. In all 5,593 plants were put out, of which only 375 were *E. rostrata*. No regular plantations were formed, but the plants were put out in blanks in the Municipal Forests and Catchment Area so as to test their capacities at various elevations and on various aspects. In September 1906 all the plants were alive, but by July only 129, all *E. Globulus*, were surviving, and of these 85 were at the lowest elevation, at which the culture had been attempted, *viz.*, 5,500 feet.

A further small consignment of *E. Globulus* seed was received in December 1906, from which 900 plants were raised These were put out during the rains of 1907 and systematically watered during the autumn.

In July 1907, seed of the following species was obtained from Tasmania, the firm supplying the seed being asked to send those

species considered most suitable for Simla whose rainfall, etc., was communicated to them:—

(1)	*Eucalyptus*	*Globulus.*
(2)	*Do.*	*pauciflora.*
(3)	*Do.*	*Stuartiana.*
(4)	*Do.*	*viminalis.*
(5)	*Do.*	*amygdalina.*
(6)	*Do.*	*hæmastoma.*
(7)	*Do.*	*obliqua.*

The plants were raised in the same way as in the two previous years, but were not put out until the following winter (February 1909) and rains (July 1909), the object being to compare the results of winter and monsoon planting. The plants put out in February were watered until the break of the rains, and all were watered from the beginning of November onwards. It was found that the monsoon planting gave the better results, and that all species did best at the lowest elevation.

The ultimate result of these three years' experiments was practically failure, for of the many thousands of plants put out, very few remain at present, and most of these are weedy-looking things which will never make big trees. Most of the casualties were due to frost, which only *E. Stuartiana* and *viminalis* showed any signs of being able to resist at all, and to which *E. Globulus* was particularly susceptible.

Since 1909 the experiment has been carried out on entirely different lines. Experimental stations were started at various elevations on the Kalka-Simla Railway line, in addition to those in Simla and the Catchment Area, so that seed could be tested at all elevations from 2,143 feet at Kalka to 7,300 in the Catchment Area. Since the object was to cover large areas of bare hillsides with forests, it was recognised that only those species of Eucalyptus would be of any value which could be introduced without requiring the tending which is given to young trees in nursery gardens. For example, it had been found by experience that in an area situated close to a municipal water standpipe it would cost Rs. 60 to water the plants for one year only. Such an expenditure was of course prohibitive;

and even were it not so, the sum required to water plants along the greater part of the railway line would be four or five times as great, owing to the distance to which the water would have to be carried. It followed that the first essential was to obtain species which could be introduced without watering. The same conditions applied, though to a less extent, to shading young plants and to putting them out into pits filled with prepared soil. It further followed that Eucalyptus could not be introduced except by direct sowings, it being very unlikely that any variety could be found which could be transplanted without watering and tending.

The object of the experiments was therefore to find by actual trial species which could be introduced at various elevations by direct sowing, on unprepared soil, without watering, and, if possible, without shading.

The experiments were carried out at the following ten stations :—

		Feet.
(1)	Kalka	2,143
(2)	Gumman	2,700
(3)	Jabli	3,950
(4)	Barogh	5,020
(5)	Solon Brewery	4,824
(6)	Kanoh	5,144
(7)	Compartment 19, Simla	6,500
(8)	Compartment 22*a*, Simla	7,100
(9)	Kariali, Catchment Area	6,800
(10)	Plantation Circle, Catchment Area ..	7,400

The Solon Brewery station was given up in 1911, as its elevation is practically the same as Barogh, and there was some difficulty about getting sufficient land. Gumman was given up in 1913, as the nursery was infested with white-ants, and it had been found that species that succeeded there did equally well either at Kalka or Jabli.

Seed was sown in lines just before the monsoon broke, in lines 40 feet long, and no watering was done throughout the year.

To test the necessity of shading, each line was divided into four sections and shaded as follows :—

Section 1.—Shaded from the beginning, but unshaded on the 15th September.

Section 2.—Shaded from the beginning, but unshaded from the 30th November.

Section 3.—Unshaded from the beginning, but shaded on the 15th September.

Section 4.—Always unshaded.

Most careful observations were made. The number of seeds which germinated in each section was recorded, and the surviving seedlings were counted every fortnight for the first year. From statements prepared from these figures it was possible to see at what season of the year most casualties occurred and also to compare the effect of the various periods of shading.

During the five years that the experiment has been carried out definite results have been obtained for the following twenty-eight species :—

No.	Name of species.	
1	*Eucalyptus*	*amygdalina.*
2	*Do.*	*obliqua.*
3	*Do.*	*hæmastoma.*
4	*Do.*	*pauciflora.*
5	*Do.*	*Stuartiana.*
6	*Do.*	*viminalis.*
7	*Do.*	*calophylla.*
8	*Do.*	*resinifera.*
9	*Do.*	*Globulus.*
10	*Do.*	*Cambagei.*
11	*Do.*	*Piperita.*
12	*Do.*	*eugenoides.*
13	*Do.*	*Goniocalyx.*
14	*Do.*	*eximia.*
15	*Do.*	*coriacea.*
16	*Do.*	*Gunnii.*
17	*Do.*	*pilularis.*

No.	Name of species.	
18	*Eucalyptus*	*Regnans.*
19	*Do.*	*Sieberiana.*
20	*Do.*	*paniculata.*
21	*Do.*	*tereticornis.*
22	*Do.*	*rostrata.*
23	*Do.*	*punctata.*
24	*Do.*	*Muelleriana.*
25	*Do.*	*leucoxylon.*
26	*Do.*	*longifolia.*
27	*Do.*	*macrorrhyncha.*
28	*Do.*	*Maideni.*

Of these the following species have proved unsuitable for introduction on a large scale :—

Nos. 2, 3, 4, 11, 17, 19, 24 and 27.

The following table shows the species it is possible to grow by direct sowings at various elevations, those *italicised* being the ones most suitable :—

Elevation.	Nos. of species.
2,000′	... *7, 20, 25.*
2,500′	... *7, 20,* 21, *22, 25.*
3,000′	... *7,* 8, 13, *20, 21, 22,* 23, *25, 26.*
3,500′	... 8, 13, *14,* 16, *20, 21, 22,* 23, *25, 26.*
4,000′	... 5, 6, 8, 9, 13, *14, 16,* 20, 21, 22, 23, *25, 26,* 28.
4,500′	... *5, 6, 9, 14, 16,* 21, *26, 28.*
5,000′	... 1, *5, 6, 9, 10,* 12, *14, 16,* 21, *28.*
5,500′	... *5, 6, 10,* 15, *16, 28.*
6,000′	... *5, 6,* 10, 15, *16,* 18, *28.*
6,500′	... *5, 6,* 10, 15, *16,* 18, *28.*
7,000′	... *5, 6,* 10, *16, 28.*

Above 5,000′ the results are not anything like so good as those at the lower elevations. Growth is extremely slow, and it is doubtful whether the plants will ever become large trees. But this is probably not so much the fault of the elevation, as of the soil, which on the higher hills round Simla is poor and

shallow. The species shown above as suitable for the higher elevations are frost-hardy and on fairly good soil could be introduced successfully.

With regard to shading it had been found that below 5,000′ it is necessary to shade from after the rains until the plants are about 2 feet high; and above 5,000′ from the time of the first frost throughout the winter.

Experiments are now in progress for twenty-seven more species, and when definite results have been obtained for these no further experiments will be necessary, as all the important species will then have been tried.

H. L. WRIGHT,
Assistant Conservator of Forests.

THE BHOWALI TURPENTINE INDUSTRY.

It was announced in a recent issue of the *Pioneer* that Mr. Gibson's visit to Europe had resulted in a new French plant being erected for the manufacture of turpentine at Bhowali and for great improvement in the method of manufacture.

We wish to take this opportunity of pointing out that either the *Pioneer's* correspondent misunderstood the information given him or that this was erroneous.

The manufacture of turpentine at Bhowali, and the designing and erection of the new plant had nothing whatever to do with Mr. Gibson's visit to European centres of manufacture, the practical results of which have, we believe, still to be proved under Indian conditions. The plant put up was the outcome of experience gained on the spot by the Divisional Officer assisted by and working in with the Economist and Chemical Adviser of the Forest Research Institute. It was carefully thought out by these officers with a view to meeting Indian conditions and the Indian demand while it was also designed to deal with a somewhat different kind of resin to that obtained in Europe. So satisfactory has this plant proved that Bhowali has already secured the following contracts for turpentine and colophony for the output of the factory from April 1914 to March 1915.

Turpentine—Turner Morrison & Co., G. I. P. Railway, E. I. Railway, B. N.-W. Railway, O. & R. Railway, R. & K. Railway and miscellaneous small contractors, while the Rosin has been disposed of to Indian Paper Mills, Shellac manufacturers, the B. N.-W. Railway and various contractors.

The supply required to meet these contracts absorbs about 46,000 gallons of the total outturn of 52,000 gallons of Bhowali turpentine and practically the total output of colophony. The industry, however, is capable of extension, and unless anything unforeseen occurs it seems probable that the major part of the Indian demand can be satisfactorily met by the United Provinces Forest Department. We understand that owing to the chemical composition of the resin of the *Pinus longifolia* being somewhat different to that of the French and American

pines, the resultant turpentine and colophony show some variation from the French and American standards, but from the fact that the Indian Railways and the trade find that their requirements are met by the Indian products, it may be assumed that these are satisfactory. What seems to us to be necessary is a recognised standardisation of our products, irrespective of the French and American standards, with a view to satisfying the Indian demand, and, once this is accomplished, that the officer in charge of the factory or factories should be held responsible that the recognised standards are maintained—in other words, we believe that it will probably be found necessary, and that the extra expenditure will be well justified, to place in charge of the manufacture an officer of higher status than formerly, who would devote his whole time and attention to this industry. He need not necessarily be a Forest Officer.

It is understood that an interesting account of the Bhowali plant and manufacture will shortly be published as a Forest Bulletin, written by Mr. Smythies, to whose exertions much of the success now obtained is due.

EXTRACTS.

APPOINTMENT TO THE PROVINCIAL SERVICE OF PRIVATE STUDENTS.

The following correspondence has been sent us for publication :—

No. 537-4F.-3., dated Rangoon, the 26th January 1914.

From—The Hon'ble MR. W. J. KEITH, I.C.S.,

Offg. Revenue Secy. to the Govt. of Burma,

To—The SECRETARY to the GOVERNMENT of INDIA,

Deptt. of Revenue and Agriculture.

Article 15 of the Forest Department Code, 7th edition, authorises Local Governments to give first appointments in the class of Extra-Assistant Conservators to candidates specially selected for direct appointment to the Provincial Forest Service, who have satisfactorily completed the course of training prescribed for them at the Forest Research Institute and College, Dehra Dun, and who have obtained from the President of that Institute a certificate to that effect. The rules regarding the selection of

these candidates are reproduced in Appendix XI of the Code. They apparently contemplate that candidates should be selected prior to undergoing the prescribed course of training.

2. The Chief Conservator of Forests, Burma, has suggested that the Local Government should promise an appointment in the Provincial Forest Service to a student who proposes to go through as a private student the course of training prescribed for probationers in the Provincial Forest Service, on condition that he obtains a certificate of having passed the course from the President of the Forest Research Institute and College, Dehra Dun. Rule 20 of the "Rules to regulate the constitution of, admission to, and studies and discipline at the Forest College and Research Institute, Dehra Dun," contemplates the admission of private students to the Provincial Service course, and Rule 38 apparently contemplates their occasional appointment to Government service. I am desired to enquire whether there is any objection to the Local Government according sanction to the Chief Conservator of Forests' proposal, or—to state the question more generally—to the grant of appointments in the Provincial Forest Service to passed private students of the Forest Research Institute and College.

From

F. NOICE, Esq., I.C.S.,

Under-Secretary to the Government of India,

To

The REVENUE SECRETARY to the GOVT. of BURMA,

Simla, the 18*th March* 1914.

SIR,

I am directed to refer to your letter No. 537-4F.-3., dated the 26th January 1914, regarding the suggestion put forward by the Chief Conservator of Forests, Burma, that the Local Government should promise an appointment in the Provincial Forest Service to a student who proposes to go through, as a private student, the course of training prescribed for probationers in the Provincial Forest Service, on condition that he obtains a certificate of having passed the course from the President of the Research Institute and College, Dehra Dun

2. In reply, I am to say that, as regards the general question, the Government of India see no objection to an appointment as probationary Extra-Assistant Conservator of Forests being offered to a man who has taken the Provincial Service Course at Dehra Dun as a private student, after reference to the President of the Research Institute and College in the first instance for a report on the character and general efficiency of the student concerned.

3. With regard to the suggestion made by the Chief Conservator of Forests, I am to point out that the promise of an appointment, if successful at the College, makes the student a Government probationary student (non-stipendiary) rather than a private student. Where men with the required educational and social qualifications are forthcoming, who are willing to take the Provincial Service Course at their own expense, the Government of India consider that the recruitment of such men is preferable to the deputation of stipendiary students, provided a non-stipendiary student obtains from the President of the Research Institute and College at the end of his course at the College a certificate to the effect that he is considered fit for appointment to the Provincial Forest Service, in addition to the ordinary certificate that he has satisfactorily completed the course of training. It would also be advisable for the Local Government to take an agreement from a probationary (non-stipendiary) student that in return for his selection as a Government student (non-stipendiary) he will serve the Local Government if successful at the College and eligible in other respects for Government service.

PINE RESIN AND ITS USES.

The following translation of an article in *La Parfumerie et Savonnerie Francaise* is reprinted from the "Perfumery and Essential Oil Record" for March 1914 :—

Resinous bodies are largely employed by the soap-maker for the manufacture of brown soaps There is, however, an essential difference in composition between resins and fatty bodies, so

although the former saponify readily and render soaps more detersive and of good lathering properties, it must not be overlooked that the products they give on saponification have not the true characters of soaps, and must be combined with fat or tallow in the fabrication of those cheap domestic soaps for which there is such a demand.

The trade in resins was for many years almost exclusively a French industry, and only in France were the pine forests turned to account for the production of resin on a commercial scale.

To-day Switzerland, Sweden, Russia and North America furnish great quantities of this useful commodity. From the point of view of quality, however, the *Pinus maritima* and *Pinus pinaster*, which flourish in the Landes round about Bordeaux, furnish a resin still much in request, and the turpentine extracted therefrom is very abundant, and one of the best varieties produced.

The resinous juice exudes naturally through incisions made longitudinally in the trunk of the pine, and the crude resin that forms after exudation is a mixture of turpentine and colophony. This crude resin is known commercially under the name of "Gemme," and for want of an exact English equivalent we must retain the word throughout this note.

By various processes, more or less improved, and consequently giving a better or inferior yield, the turpentine is separated from the impurities it contains. The crude, semi-solid turpentine is generally put into sacks of coarse cloth, and heated by steam till the mass melts and trickles through the cloth, leaving behind the leaves, chips of bark and dirt with which it was mingled. Sometimes all that is done is to heat it up gently in large, flat cauldrons, skim off the impurities that will float, and filter out the remainder through straw mats.

Usually, and specially in the Landes, the turpentine is distilled off without preliminary treatment, either over naked fires or by steam; in the latter case the colophony obtained is much paler, but this is the only advantage, for the steam method, though easier to work, is very expensive, and in the Landes has not been adopted to any great extent.

The "gemme" collected from April to September contains up to 22 per cent. of volatile turpentine, that from September onwards only about 14 per cent. The average composition is oil of turpentine 16 per cent, colophony resin 70 per cent, water 10 per cent, and impurities 2 per cent.

The constitution of coniferous resins has been closely studied by various workers, notably by Blanchet and Sell, Rose, Liebig, Maly, and others, and, of more recent years, by Vezes, Gallon, and Blarez in France, and Klason and Kohler in Germany.

All these resins have the property of solidifying on exposure to the air, and consist largely of acid bodies. According to Kohler the parent substance of resinic acids is an aldehyde, a species of camphor having the formula $C_{20}H_{18}O$, and the union of two molecules of this body with absorption of oxygen and elimination of water gives the resin acids. Any further discussion of the chemistry of the subject, interesting as it would be, is outside the scope of a commercial note.

From the commercial point of view, pine resins are divided into "Galipot" (white resin), Colophony (clear yellow resin), Burgundy Pitch, Yellow Resin (see below), and Rosin Pitch.

Galipot is the freshly-exuded "gemme" collecting around incision in the bark, and more or less hardened by oxidation and loss of volatile oil. It is formed during the winter; the sap at that time being dense, and flowing with difficulty, accumulates on the tree, and can be detached by some kind of cutting implement. The summer exudation being quite liquid is collected in pits cut in the wood with an axe near the base of the trunk. Both varieties are used for the distillation of turpentine, the only difference being in the percentage yield of volatile product.

Colophony is the residue from the crude turpentine after removal of the volatile oil. The colour varies according to the care taken during distillation, a process that sounds simpler than it is in reality when done over naked fires. Steam distillation is much more easily regulated, and gives a beautifully pale resin, but the yield of oil is not appreciably better and the expense nearly double, so the former process is generally employed. When

the distillation is finished the fluid colophony is run out into little channels moulded in the sand, and of such dimensions as to give blocks weighing 50 or 100 kilos. This colophony is the variety of resin generally used for soap-making.

"*Resinjaune*" is a colophony into which has been incorporated, while fused, 5 or 6 per cent. of water. The colour is thus much paler, but the product is friable and has lost its transparency. This substance is inferior to the true colophony, and if desired can be somewhat improved by gently melting and adding 20 to 25 per cent. of the tenacious "galipot." In spite of its inferiority, this material does very well for soap-making.

Burgundy Pitch has a rich and pleasant aroma. It is a natural "gemme" from *Pinus picea*, not distilled as is the "galipot," and is the most esteemed of all the French resins. The yield, however, is very meagre. It is of a dark shade, is used to some extent in soap-making, but it is upon its use in medicine that its reputation is founded.

Finally, the *Black Pitch* is the residue from the filtering mats. The straw, retaining all the dross, together with a certain amount of resinous matter, is gently ignited upon a sloping floor, and the liquefied resin runs down into a receptacle to separate into solid pitch and "pitch oil." The latter is drained off, and the pitch further heated until it solidifies into a black, shiny, brittle mass—black pitch. This residue is not used in France by the soap-maker, but in Italy, in conjunction with oleine, it is used for a popular variety of domestic soap. American colophony is generally very pale, and much used for pale-tinted soaps.

According to Vallier, resin should only be used in soap in the proportion of one-third with two-thirds of fatty bodies. The product is then very fine, gives a good lather, and is detersive even with sea-water. The method of Vallier is as under :—Into 500 kilos. of boiling lye at 11°B. is run a liquefied mixture of 300 kilos. of tallow and 200 kilos. of palm oil. After stirring there is added 25 kilos. of lye at 12°B., boiling is continued for three or four hours, and successive additions of caustic lye at 18°B. made up to 500 kilos. Boiling is continued until the supernatant

ye has a density of 20°B. At this point 200 kilos. of resin and 150 kilos. of caustic potash lye at 22°B. are introduced; boiling is resumed for one hour. Then the steam is stopped, the mass well stirred, left to settle one night, and then run off into moulds, there to remain for a week.

Resin soap without fat has a soft consistency, is no use for domestic purposes, but is much employed in the paper trade. This variety is made by boiling the resin with a dilute solution of carbonate of soda, which does not entirely saponify the resin; in fact the product is, strictly speaking, an emulsion of resin soap and unsaponified anhydrides.

According to Ersham, the proportions used for making resin soap for the paper trade are the following:—300 kilos. of colophony at 150° or 160° are stirred little by little with 30 kilos. of caustic soda into 500 litres of water, and allowed to stand 15 days, after which the water is removed and the soap transferred to drums. When used, one part is boiled up with 33 parts of starch in 50 parts of water. A mixture of 160 kilos. of this mucilage with 100 kilos. of paste is used for sizing the paper.

Numerous patents have been taken out for resin soap, but the principle does not vary, modifications of proportion and temperature alone being made.

For the preparation of insoluble resin soaps no fat is used, and any excess of alkali avoided, and in hot solution are used for the preparation of insoluble metallic resinates by precipitation.

Finally, for making adhesive soap for the driving belts of machinery, resin is thus used:—

1. Colophony 30, fish oil 10, neutral wool-fat 3, tallow 3, soda lye 25 degs. B. 4, mineral oil, specific gravity ·885, 50.

2. Crude wool-fat 69, colophony 17, soda lye 14.

The mixture generally made in iron pans, either by naked heat or steam.

Resin also enters into the composition of soaps used for dressing hemp cordage.

Many soap-makers mix the semi-solid resin soaps with hard soaps to get a cheap and remunerative article.—[*Indian Trade Journal*]

SUBSTITUTES FOR TEAK.

For many years past it has been our custom to reproduce monthly the teak report of Denny, Mott and Dickson, Ld., and their views on the trade of last month are to be found in the next column. The current circular, however, deals with more than teak proper, and goes into the merits of teak compared with substitutes. The firm state:—

The high cost of teak during recent years has naturally stimulated the search for a wood which might possess some of the special qualities which have made teak to be so appreciated for construction, and especially for work entailing the combination of wood and metal—teak alone being recognised as possessing the unctuous nature which prevents steel or iron corroding when in contact with it. No other wood can yet be claimed as possessing the special properties of teak, but some woods have been brought forward for experiment, and a loose habit is creeping in of affixing the word "teak" to such woods, *e.g.*, yang teak, eng teak, Borneo teak. Consumers should be on their guard against such confusing nomenclature. Out of the above woods yang raised some hope of possessing the *permanent* greasy property of teak, but although the tree is tapped for oil, experiments do not show any greasy quality of a permanent nature, whilst its repute in Siam for durability is not good. The timber merchant is only too keen that *wood* and not metal or cement compositions should displace teak in construction, but it is worse than useless that consumers should be confused by false nomenclature. The annexed correspondence with the Director of the Royal Botanic Gardens, Kew, should be of interest to all concerned in the use of teak

14 FENCHURCH STREET, E.C.

W. WATSON, ESQ., A.L.S., *12th January*, 1914

Curator,

Royal Botanic Gardens, Kew.

DEAR SIR, Various causes have so increased the cost of teak (*Tectona grandis*) timber during recent years that wood substitutes are being eagerly sought for. This fact is leading to some such experimental substitutes being so offered and talked of in connection

with teak as to lead shipbuilders and other constructors into the mistake of buying such substitutes as teak, *e.g.*, Siamese yang is being in some directions called "yang" teak It is therefore very necessary, not only for commercial but Government construction (for Navy and Army purposes), that an authoritative explanation of what is the essential, both botanical and otherwise, difference between teak and such possible substitutes should be laid down. We, therefore, as leading importers, ask you, and also indirectly that we may give such information to H. M. Admiralty and commercial constructors of ships, to define the difference between the origin and qualities of the two samples herewith :—

No. 1 is a sample of Rangoon teak from the chief Burma shippers (The Bombay-Burma Trading Corporation, Ld.).

No. 2 is a sample of the yang, or sometimes wrongly called yang teak, from Siam, from where it is chiefly supplied, although it also grows in Burma

We may mention the old rough and-ready distinction between teak and other woods has been that the essential oil in the wood is in no way volatile, and therefore teak can be used in contact with iron or steel without injury to either material, which could be claimed for no other commercial wood. Yang is tapped in Siam for oil, but whether through such oil being of a different nature, volatile, or possibly differently distributed in the pores or texture of the wood, as compared with teak, we have no evidence that it can be used in contact with iron or steel without setting up rust or corrosion

It is only such an unquestionable botanical authority as yourself, or possibly a laboratory chemist, who can define the points we seek to elucidate, *viz.*, the essential difference between teak and yang wood; and if in supplying such information proper fees are incurred, we shall be only too glad to pay the same in order to establish a solid reference for the guidance of constructors and wood merchants.

We are, dear Sir,

Yours faithfully,

(Sd.) DENNY, MOTT & DICKSON, LD.

To the above, the Director of the Royal Botanic Gardens, Kew, replied sending a "report on the samples of teak and yang woods recently submitted for examination," *viz.* :—

The sample of "yang" (specimen No. 2) is similar to a specimen under that name in the Kew Museum. It appears to be the wood of a species of *Dipterocarpus*, and is thus allied to "eng" (*Dipterocarpus tuberculatus*) and "gurgun" (*D. turbinatus*). Specimen No. 1 is characteristic teak (*Tectona grandis*).

Ready methods of distinguishing teak from possible substitutes cannot well be formulated, but teak and yang can generally be distinguished without difficulty. A cleanly-cut transverse surface of the wood examined with a lens will show fairly conspicuous concentric zoning in the case of teak (except where the growth of the wood has been very slow), but not in yang. Another difference which would probably always hold good is the following. Radially cut shavings or chips of yang wood, after being boiled in water for two or three minutes and then soaked in a watery solution of ferric chloride for a few minutes, show conspicuous blackening of the medullary rays, a reaction which is not obtained with teak under the same conditions. Yang contains a certain amount of a resinous or balsamic substance with perhaps a volatile constituent, but this is unlikely to cause any actual rusting or corrosion of iron or steel. The substance in the medullary rays, however, which gives a black reaction with ferric chloride might possibly cause blackening or corrosion of the surface of iron or steel in contact with the wood especially in the presence of damp. In yang the resin or balsam is contained in the secretory canals or ducts, while in teak the resinous substance present lies in the cavities of the cells and fibres of the wood.—[*Timber Trades Journal.*]

A NEW PROCESS FOR WOOD PRESERVATION.

A process for wood preservation which has been experimented upon for some years past is now being employed on a practical scale in the United States, says the *Revista Minera*, for railway sleepers and for wood destined for bridge construction.

The preservative substance is a liquid paraffin with the addition of silica and a certain quantity of naphthaline. This last, thanks to its natural volatility, penetrates into the pores and interior canals of the wood and swells them, producing an active circulation whereby the moisture and sap are replaced by it. On solidifying it fills the interior spaces with a compact substance impervious to water and organic acids, and possessing antiseptic properties which assure an indefinite preservation of the wood. The silica is used in the form of kieselguhr.

Wood treated by this process is impregnated throughout its whole volume, whatever may be its dimensions, in a maximum time of four hours, whereas the process employing creosote necessitates from twelve to twenty-four hours. Wood thus treated has no odour. The treatment increases the strength of the wood, and has the advantage of preventing the attack of marine salts, owing to the presence of the silica. This property is a useful one in view of the employment of wood for piles, dock walls and marine works, etc. In addition, the process is applicable to certain species of wood, such as evergreen oak, which could not be impregnated by other processes. The treatment consists in submerging pieces for a varying period according to their dimensions, but never in excess of four hours, in a warm bath of liquid paraffin and naphthaline containing silica. There is no complicated apparatus required, there being only necessary an open bath with steam heat and the necessary plant for handling the wood. The trial plant consists of a vertical cylindrical vessel containing about 60 kilogs. of the preservative mixture. The introduction and removal of the pieces is effected by means of tackle fixed to the roof of the factory. The simplicity of the method permits of the installation of portable plant for the treatment of sleepers and other pieces on the spot, so that landowners, for example, may have installations for impregnat-

ing, fencing, etc., where the wood is to be employed. Wood thus treated is absolutely impervious to water. Nails and screws grip better than in creosoted wood, and owing to the perfect penetration of the substance into the interior it may be employed in joinery and carpentry without fear as to the impregnation of the centre.

The cost of material is not high. It has been calculated at 0·30 to 0·35 francs, approximately, per kilogramme, and repeated trials have shown that a small quantity per cubic metre is sufficient to completely impregnate the wood. In cases where partial impregnation is sufficient for preservation the cost will, of course, be greatly reduced. Experience has shown, according to the promoters of the method, that complete indefinite impregnation of the wood by the process can be obtained at much lower cost than by the creosote method, and the other processes employed in practice.

Railway sleepers have been treated in a small experimental plant, and a series of trials carried on with sleepers of pine and oak has shown that complete impregnation requires from 32 to 38 litres for from 27 to 32 kilogs. per cubic metre of wood; some woods such as ash, require a larger quantity. It is possible to treat newly-cut wood and obtain equally good results as with seasoned wood. [*Chemical Trade Journal.*]

FIRE-PROTECTION IN CHIR FOREST.

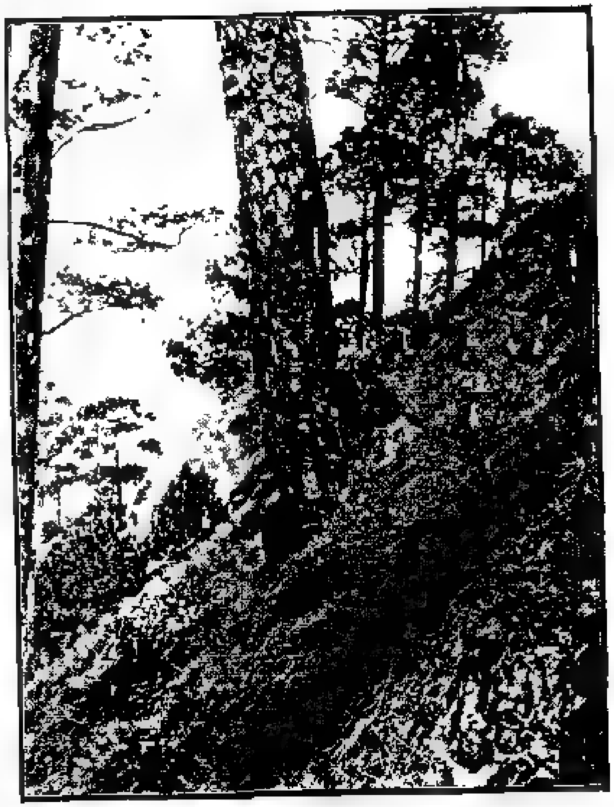

Photo.-Mech. Dept. Thomason College, Roorkee.

Fig. 1. Shows a large rock fallen against a tree which being damaged was burnt out at place of damage.

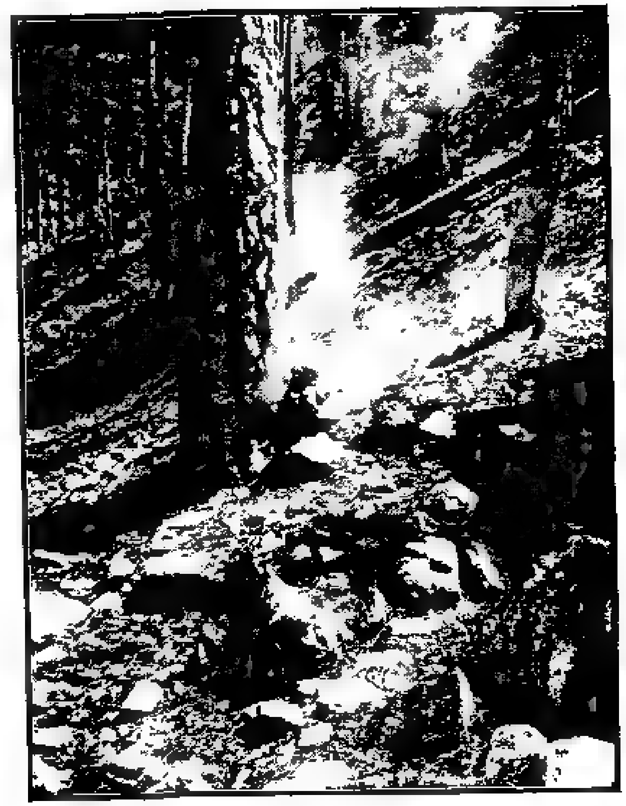

Fig. 2. A burning log rolled up against a tree and still remains burning in contact with stem two days after fire has passed through the area.

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FIRE-PROTECTION IN CHIR FOREST.

In the *Indian Forester* for January and February 1911, Mr. E. A. Smythies wrote as follows :—

"It is a self-evident fact (and any one who has ever seen a Chir forest will bear witness to it) that regular annual burning does absolutely no harm to anything above the seedling and young plant stage."

And again :—

"Annual fires do not do a scrap of damage to anything above the seedling stage."

These are very strong statements, and it would appear that there could not be much further to say on the subject. As, however, I have had the opportunity of seeing a good many chir forests in the Garhwal district of Kumaun, and as my experience of them does not agree with Mr. Smythies' statement quoted above, I venture to record my own experience. I wish it, however, to be understood that I know practically nothing of the Almora and Naini Tal chir forests (with which, I believe, Mr. Smythies was chiefly concerned), and my remarks must be taken as applying

primarily to the chir forests situated in the Pindar Valley of Garhwal and in a lesser degree to some other parts of Garhwal.

These Pindar forests cover an area of about eighty square miles and contain some of the most valuable timber of the district. The trees grow to an immense size, ten to twelve feet girth being by no means uncommon.

To describe the forest in detail over such a large area would be impossible, but there are certain outstanding characteristics applicable to these forests as a whole. Firstly, as regards the forest, it is overmature, extensive areas containing an almost uniform forest of first-class trees. This is also evident from the result of the enumerations which have just been completed and which show an average stock per acre of 5 first class, 8 second class, 9 third class, 7 fourth class, and 4 fifth class trees. From this it *will also be observed that regeneration and advance growth are* conspicuous by their absence. Another important feature is the steepness of the ground, the slopes throughout being remarkable for their precipitous nature.

About 20th April last year the firing of these forests commenced. The fires continued burning throughout the valley till nearly the middle of May by which time practically every acre of forest had been burnt. During the whole of this period the valley was filled with a dense veil of smoke which completely obscured everything over a mile distant

These forests have been burnt annually for many years, as it has only recently been decided to reserve them and previous protective measures were spasmodic and quite ineffectual. The progress of the fire was slow owing to there being the accumulation of but one year's needles and the fire was frequently checked by a small dry nullah or even a rocky ridge in which case the villagers helped the fire across whatever obstacle existed.

During the whole of the month whilst these fires were in progress, I was constantly going through the forest and saw it in every stage of burning and after it had been burned. The damage caused by these annual fires may be classed as due to either (*a*) the destruction of regeneration and advance growth,

FIRE-PROTECTION IN CHIR FOREST.

Fig. 3. Shows two trees which were standing before fire passed through the area but which burnt through at base and fell and as shown in photo. are still burning.

Photo.-Mechl. Dept., Thomason College, Roorkee

Fig. 4. Shows log having rolled up against stem has burnt out the latter at place of contact.

or (*b*) the destruction of trees after they have passed the pole stage.

This, of course, is where my experience differs from that of Mr. Smythies. Mr. Smythies does not allow that any harm is ever done under head (*b*). As regards the harm done under head (*a*) my observations in general agree with all Mr. Smythies has written on the subject. I will not therefore further discuss the subject of damage to regeneration and advance growth. It is quite certain that fires, whether annual or periodical, destroy this in a wholesale manner. It is equally certain that this destruction may cause no direct harm in areas not under regeneration, in fact may even be beneficial. But the point on which I wish to lay special stress is that fires, whether annual or periodical, in the Pindar forests in their present state do cause incalculable harm to the standing crop which has passed the pole stage. In this respect the Pindar forests may or may not be abnormal, but here it is undoubtedly of paramount importance and should completely dominate every argument for allowing the continuance of fires in these forests.

The harm to which I refer is caused by the fire burning through the tree at the base. The tree then falls. After this the fire may continue to consume the fallen stem until it is completely burnt away, or if something occurs to arrest the fire, it may only consume a portion in that year, the remainder providing fuel for next year's fire. It must not, however, be supposed that when a fallen tree burns away, the damage ends here. This is only the commencement. The fallen stem rolls up against one or more other standing trees, and as the fire slowly consumes it the flames ignite the stem of the tree against which the log has rolled. Whether the tree was previously sound or not, its bark cannot resist the flames of a burning log in actual contact, and thus the base of a new tree is hollowed out by fire, and though it may not fall the same year or even for a number of years every year the fire running through the forest will or may ignite the exposed surface and the tree is doomed. In this way a fallen stem may ignite the bases of three or four other trees before it is

itself consumed and the number of affected trees increasing in geometrical progression wil. rapidly extend over the whole forest.

This is in fact what is actually happening, and taking the whole of the Pindar forests together, I believe it would be well within the mark to estimate that 20 per cent. of all trees over three feet girth are damaged at the base to such an extent that they must be eventually destroyed if fires continue. I was unable to devote the necessary time required for enumerating the actual number of damaged trees over selected areas, but I observed many areas very carefully, and I feel certain that in many parts the percentage of damaged trees is as high as ninety, though in others it may drop to about five. Southern slopes have usually a higher percentage than northern, and this I attribute to the extra dryness causing fiercer fires and to the absence of moist intervening evergreen ravines which may isolate a portion of forest for several consecutive years. Steep slopes, the bottoms of ravines, areas in which fellings have taken place on a large scale, and areas near villages or close to much-frequented roads also show higher percentages and for this the reasons may be inferred by a consideration of the various causes which permit fire to ignite the stems of trees. These are :-

(a) *Artificial*—

(i) The extraction of wood for torches. Pieces two to three feet in length are usually hacked out of the living stem at a convenient distance from the ground.

(ii) The stems of trees are cut into to ascertain whether the grain renders the timber suitable for building purposes. Pieces of various dimensions are extracted for this purpose and at any convenient height from the ground. Any tendency to twisted fibre is thus detected without felling the tree.

(iii) The extraction of logs by allowing them to slide down the hill without any kind of check or guidance. The logs naturally run up against standing trees and produce injury of varying extent low down near the ground.

(b) *Natural*—

(iv) Boulders get loose and roll down the hill striking the stems of trees as they go. I have seen damage of this kind as high as twelve feet from the ground formed by the boulder in the middle of one of its jumps.

(v) Stems of fallen trees roll down hill till they get caught up against the stems of standing trees where they burn away and at the same time ignite the stems, against which they have rolled.

Of these the most potent cause is undoubtedly number (v) as its effect is cumulative, and of the remainder numbers (i) and (ii) are probably the next most harmful.

Taking therefore into consideration the large number of valuable trees which are at present in such a damaged state, that they are liable to catch fire and in time to fall and ignite other stems, I think that no other argument which could be brought forward would be sufficiently strong to make the continued burning of these forests admissible.

Of course, it may be found as in the Punjab that fire-protection is impossible, but at least a serious attempt should be made. The following extremely rough calculation will at least give a sort of idea of the immense loss to Government which these fires have in past years entailed. Assuming as stated above that 20 per cent. of all trees over three feet girth are seriously damaged and assuming that these trees will have all fallen in twenty-five years' time, then the annual number which fall is about 10 per square mile or a loss of about eight thousand rupees per annum at present rates in the whole of the Pindar forests. These figures, however inaccurate, at least show that there are in certain Garhwal forests weighty reasons in favour of fire-protection, and though they are due to what are undoubtedly largely abnormal conditions, it must be remembered that these abnormal conditions prevail over very large areas and cannot be ignored in any general treatment of the question of fire-protection in chir forests.

A. F OSMASTON,
April 1914. *I.F.S*

LIST OF TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN FOREST CIRCLE OF THE C. P.

(PART VI.)

BY H. H. HAINES, I.F.S.

[*Part V appeared in July* 1914.]

L.—ACANTHACÆ.

Asteracantha longifolia, *Nees.* Syn. Hygrophila spinosa, *T. Anders.*

A conspicuous ditch or marsh herb, 3—4 feet high, with long willow-like leaves and dense spiney whorls of handsome purple flowers, the lower lip ·5″ broad with yellow palate. Spines usually 6 in a whorl, often 1″ long.

Fls. *Nov.-Dec.* Common in all divisions.

It is only referred to here as being (*fidi* Witt) a favourite food of camels and called in Berar "Unt Katara."

Petalidium barlerioides, *Nees.* Mormari, *Mar.;* Divari, *Gond.*

A struggling shrub, sometimes 5 feet, with straw-coloured twigs and ovate-toothed or crenulate acuminate puberulous leaves (which are very few at the time of flowering) 2—4″ long or even attaining 6″ by 4″ with the base decurrent on the long petiole.

Fls. rather large, white, in dense spikes (abbreviated lateral branches). Readily recognised by the large green veined pairs of bracteoles ·75″ long, strongly ribbed lower lip of corolla, and the long fulvous hairs within it. Anthers 4 with long spurs (Cp. also Daedalacanthus and Justicia betonica).

Fls. *Feby.—April.* Fr. *April.*

Frequent, Bh.; N. Ch.; Bal., etc. Forms a dense undergrowth (formerly called Strobilanthes) in Allapalli (S. Ch.) and some other forests.

Daedalacanthus purpurascens, *T. Anders.* Karse Walam, *Gond.*

A handsome undershrub, 2—4 feet high, with puberulous somewhat angled branches and large ovate acuminate leaves 4—6″ with

the base decurrent on the slender petiole and with 6—8 prs. sec. n. Fls. lilac or blue-purple 1—1·5" long and ·75" diameter in dense bracteate spikes, on long or short peduncles. Bracts imbricate pale with green veins.

Fls. *Nov.—Feb.*

In the damper forests or ravines. Girola (Bh.), Pondi and Sonakhan range (Bil.); S. Ch.; Balod range (Rai.). Also in other divisions.

Strobilanthes auriculatus, *Nees.* Marmari dara, *Gond.*; Mohate, *Baiga*; Lamani, *Chh.*

An undershrub, 2—6 feet, with simple oblong or ovate or lanceolate crenate leaves attaining 10" long and 2·25" broad, one in a pair often larger than the other. Very beautiful when in full flower with blue flowers 1" long in dense elongating spikes at first 1—3" long with densely imbricate obovate obtuse glandular and pubescent bracts.

Fls. (periodically) *Nov.—Feb.* Fr. *March-April.*

All divisions. Gregarious in the damper forests, especially along rocky ravines. It is said to flower every six years, and a general flowering took place in 1911, when some nalas (*e.g.*, Bodal-Kasa in Sonawani forest, Balaghat) were a mass of blue. A general flowering took place in Chota Nagpur in 1898.

Barleria Prionitis, *L.* Koti, *Mar.*; Gormiri, *Tel.*

A prickly undershrub, 2—5 feet high, with glabrous elliptic leaves 1·5—4" long, acuminate at both ends, and yellow fls. in the leaf axils and in terminal spikes with elliptic spine-tipped bracts. The sepals also are sometimes spine-tipped.

Fls. *June—Jany.* Fr. *Jany —March.*

Under shade, frequent. Also in open forest.

The typical plant according to Clarke (in F. B. I.) has the "bracteoles very small, reduced to bristles or O, sepals broadly-lanceolate acuminate, leaves glabrous or sometimes tawny sericeous beneath." The following therefore appears to be a variety :—

Var.

Leaves oblanceolate densely sub-strigosely hairy beneath. Bracts oblanceolate ·5″. Bracteoles ·4″ subulate, the midrib produced into a long spine.

On quartzite rocks, Warora range, N. Ch.

Barleria reticulata, *Haines.* (near longiflora, *L. f.*).

A much branched hoary shrub, 2—3 feet high, somewhat resembling a Sage bush, with glandular hirsute branches and white-tomentose ell. or ovate leaves ·75—1″ long with obtuse or acute base. Petiole ·25—·5″. Fls. in numerous short terminal spikes with 2 spreading linear-oblanceolate bracteoles ·3—·4″ long and two large obovate scarious veined spinulose-toothed sepals ·5—·7″ long.

Corolla not seen but, from the remains of the style, the tube is over 2·25″ long and (from a dried up flower bud) somewhat pubescent without, lobes acute. Capsule brown ·5″ with shaggy seeds.

Fls. Probably *Oct.-Nov.* Fr. *Jany.-Feby.*

Quartzite rocks, N. Ch.

(In default of fully developed leaves and flowers, I have not yet given the Latin description of this species. The sepals in texture and toothing resemble those of pilosa.)

Barleria montana, *Nees.*

An undershrub, 3—4 feet high, with long branches from the root, ovate-lanceolate or lanceolate sub-acuminate leaves 5—6″ long below, smaller upwards, pale glaucous beneath, glabrous, lower very shortly petioled. Fls. handsome axillary and in dense spikes 3—8″ long, with foliaceous bracts and linear bracteoles. Corolla nearly 2″ by 1·5″ rose-coloured.

Fls *Oct.-Nov.* Fr *Jany.*

Moister forests, along valleys and shady sides of hills.

Pench and Arvi (on laterite) Forests (N. W.); S. Ch.

Barleria Gibsoni, *Dalz.*

Closely resembles B. montana, but said to differ in the leaves being acute instead of acuminate, the corolla larger and in the

seeds being *glabrous* instead of densely hairy. I doubt their specific distinctness.

Chanda.

Barleria cristata, *L.*

An erect or diffuse undershrub, 1—3 feet high, with lanceolate, oblong-lanceolate or elliptic leaves 2—5·5″ acute or acuminate, pale beneath and axillary and terminal clusters of light rose-coloured flowers 1·5—1·75″ long, with a pair of large more or less spinulosely-toothed sepals. Branches and leaves always more or less strigosely hairy.

Fls. *Sept.—Nov.* Fr. *Oct.—Jany.*

Common in the forests in all divisions. It is often covered with flowers in sunny positions, and is then very handsome. Frequently introduced into gardens.

Barleria strigosa, *Willd.*

An undershrub, 2—4 feet high, with large ovate acuminate leaves 4—8″ by 2—5″, decurrent on the petiole and large handsome azure-blue flowers 2″ long and 1·25″ wide, in dense bracteolate one-sided spikes. Easily recognised by the two larger sepals being imbricate in a row on the upper surface and the bracteoles in rows on the sides of the spikes.

Fls. *Oct.-Nov.* Fr. *Dec.*

In shady damp valleys, common.

Justicia Betonica, *L.*

Undershrub, 2—4 feet high, with ovate-lanceolate leaves acuminate at both ends and small white rose-spotted fls. in axillary and terminal 1—3-nate spikes conspicuous from the closely-seriate white green-veined ovate mucronate bracts.

Fls., Frt. *Nov.—Jany.*

Rocky ravines, in most divisions.

Rhinacanthus communis, *Nees.*

A slender divaricately branched undershrub, 3—4 feet with large elliptic, obovate or ovate-oblong acuminate leaves, attaining

9·5 by 3·25", narrowed into a petiole 1·5—2 long, gradually smaller upwards, and large spreading nearly naked 3-chotomous panicles of pure white lipped fls. Corolla-tube narrowed ·8" long, lower lip ·6 by ·5", 3-lobed.

Fls. *Jany.—April.*

Rocky ground under shade, Sironcha forests.

[C B.—Clarke throws doubt on this plant being wild. It is, however, quite wild both here and in Bengal.]

Adhatoda Vasica, *Nees.* Adorsa, *Mar.* Is a large shrub frequently cultivated, wild in the United Provinces. It has large ell. leaves with fœtid smell and dense spikes of large white-lipped fls.

It is a good insecticide.

Numerous herbs and small undershrubs of this family occur in the forests. Among these may be mentioned *Andrographis paniculata*, Nees, called Chiretta or Chirainta, an erect herb, 1—3 feet with lanceolate glabrous leaves, about 2·5" and small-lipped flowers, ·5", vertical on spreading panicled racemes. It is widely used in fever (not to be confounded with the true 'Chiretta' = Swertia sp.).

Also numerous species of Justicia and Lepidagathis; Hemigraphis latebrosa, with pretty little blue fls. and soft leaves; Ruellia suffruticosa, R. Beddomei, and R. prostrata with purple fls. and Dischoriste vagans with blue fls.

Various species of climbing Thunbergia, and numerous shrubs are also in cultivation for the beauty of their fls., while Thunbergia fragrans occurs wild.

LI.—VERBENACEÆ.

Lantana Camara, *L.* (Syn. L. aculeata, *L.*)

A straggling or scandent shrub, with small recurved prickles on the brown branches. L. cordate serrate rugose pubescent 2—3". Fls. crimson, red or yellowish in axillary stalked heads. Fr of small black drupes.

Fls. and Frs. principally in the rains.

A very common introduced shrub, but showing little tendency to run wild in the Southern Circle. It is a useful hedge plant if cut back.

Callicarpa arborea, *Roxb.*

A small or m. s. tree with pale sand-coloured bark, soft whitish blaze with yellow streaks, 4-angular tomentose branchlets, large ovate to ovate-lanceolate or ovate-oblong acute or sub-acuminate entire leaves 5·5—12" long, tomentose beneath with a rounded base and 8—12 prs. of secondary nerves and strong cross tertiaries. Petiole ·75—1·5". Fls. small, lilac-purple in dense 2-chotomous corymbose cymes 3—5' across. Drupe purple ·1—·12".

Fls. *May-June.* Fr. *Aug.—Nov.* Evergreen.

Very rare. On the ghats in Dhiri-Mangli forest (Bal.).

Tectona grandis, *L. f.* Sagwan, *Mar.;* Teka, *Gond.;* Teku, *Tel.*

The Teak tree.

A small or large tree with light-coloured bark, peeling off in thin narrow longitudinal strips.

It will probably reach 6 feet girth while sound in many of the South Chanda forests and in a few valleys, with good drainage and soil derived from metamorphic rocks, in other divisions. On trap it is a small tree. Usually absent from quartzite plateaux and from the Sal areas, though occasionally found mixed with Sal.

Fls. *July-Aug.* Fr. *Nov.—Jany.*

Premna latifolia, *Roxb.* Var., viburnoides. Dakar, *Mar.*

A small tree with light-grey thin bark and white blaze. Leaves thin, usually broadly ovate, obtuse with obtuse base, suddenly shortly cuneately decurrent on the petiole, 2—4", drying blue-green, minutely puberulous above and pubescent on nerves beneath, sec. n. 4—7 each side. Fls. small, white, in terminal corymbose compound sub-sessile cymes 1—5" broad.

Calyx with 5 small sub-equal teeth. Corolla white, tubular 2-lipped ·2″ long, upper lip notched, lower longer with 3 large obes. *Drupe* ·25″ diameter, black.

Fls. *June-July*. (Elsewhere *April-May*.)

Rare. Dhaba forests (S. Ch.).

The typical plant has tapering leaves and petioles only ·25—·75″ long, and dries nearly black, the Chanda plant has petioles up to 1·6″. The smell is characteristic, somewhat fœtidly-aromatic.

Premna barbata, *Wall.* Sendri, Sendu, *Gond.*

A small tree with yellow-brown twigs. L. ovate-lanceolate, more rarely ovate-oblong or ovate, sub-acuminate to long-acuminate with rounded or broadly cuneate base, 3·5—6″, drying green, usually some at least on the tree more or less serrate, nerves usually puberulous (the new shoots are hairy) petiole ·75—2·5″. Fls. small, white, in terminal corymbose peduncled cymes 1—2·5″ broad. Calyx 4-lobed or one lobe again lobed. Corolla under 2″ long. Drupe globose or pyriform ·2″ diameter.

Fls. *April-May*. Fr. *May-June*.

Occasional in valleys. Sonawani forests and Dhiri-Mangli forests (Bal.); Pantora range (Bil.) under the hills.

Premna gmelinoides, *Haines* (near flavescens, *Ham.*), Kamar, *H.*

A tree somewhat resembling (when growing) *Gmelina arborea*, attaining 4 feet girth with light-brown bark and light-coloured blaze with brown spots and streaks. Innovations tomentose. Twigs light-brown, somewhat striate and puberulous, with large broadly elliptic, ovate and ovate-cordate leaves 5·5—10″ by 3—7″, acute or shortly acuminate, entire or coarsely dentate, with sweet aromatic odour, dotted with minute yellow glands both sides, mature thinly, pubescent beneath and on the nerves above with simple or forked hairs; base rounded, oblique or cordate; sec. n. 6—7 each side strong and tertiaries raised, more or less scarariform. Petioles 2—5″ joined by a villous and glandular line. Fls. in broad cymose panicles with linear-filiform bracts ·25—·7″ long. Peduncles short.

Calyx gland-dotted more or less 2-lipped (in fruit) with the lips shallowly lobed or entire. Fr. ·12" diameter.

Fls. *July-Aug.* (?) Fr. *Aug.-Sept.*

In the hills of Bhandara, Balaghat. Khairagarh frequent, on schist and quartzite rocks ; elev. 1,800 feet.

Note.—I have not seen the tree in flower and the remains of the single inflorescence was badly decayed, but it seems advisable to give the tree a nom-de-plume. It is the same tree as Premna No. 3, described on p. 482 of "Forest Flora of Chota Nagpur."

Premna tomentosa, *Willd.*

A m.s. tree with light-brown bark and densely yellow woolly tomentose twigs and innovations. Leaves 5—8" (up to 10 by 6·5" on large coppice shoots) ovate acuminate with cordate base, mature very stellately tomentose beneath and covered with minute glandular scales between the hairs with the characteristic smell of Premna, slightly rough above after the fall of the hairs. Petiole 1—2". Panicles compact 2—4" diameter with small greenish-yellow fls. Calyx more or less 5-lobed. Drupe ovoid.

Fls. *March-April*, with the new leaves. Fr. *May*. (Times of flowering and fruiting and description of fls. and fr. from South Indian specimens.)

Valley near Wamanpalli, S. Ch

Premna herbacea, *Roxb.*

An interesting little plant, with a stout woody rootstock and herbaceous shoots 1—4" high, with sessile obovate coarsely serrate leaves 2—4", usually appressed to the ground. Fls. very small in white corymbs 1·5" diameter.

Fls. *April—June.* Fr. *May—July.*

On open ground annually burnt, frequent. The plant is said to be used medicinally.

Gmelina arborea, *L.* Gambhar, Kamar, *H.* ; Shewan, Siwan, *Mar.* ; Kursi, *Gond.* ; Kasamar, *Kol.* ; Gumar Teku, *Tel.*

A m. s. tree (rarely large in the C. P.) with light-grey bark exfoliating in paler-coloured patches when old, and thick pale yellow blaze with thin chlorophyll layer outside and white inside.

L. broadly ovate or cordate 4—9" by 2·5—8," base 3—5-nerved and usually cuneate on the 2—6" long petiole. Fls. irregular 1—1·5" long-reddish or brown and yellow in lateral and terminal panicles.

Frt. a succulent drupe, 1" diameter.

Fls. *Feby.—April.* When more or less leafless. Fr. *May-June.*

In all divisions, especially on the cool sides of the hills. The wood is largely used for making drums. It is good for planking and does not warp or shrink, and is worthy of more attention in silvicultural operations. Cattle and deer are very fond of the fruit.

Var. α **typica.** Leaves densely stellately hairy or tomentose beneath. S. Ch.

Var. β **Glaucescens,** *Clarke.* L. glabrous and glaucous beneath, covered with microscopic glands. In all divisions.

The embyro, on germination, break off a cap from each fertile loculus of the stone (as in Teak). The seedlings have strongly toothed leaves, and such toothed leaves are sometimes found on mature plants.

Gmelina asiatica, *L.* Chinta ganer Chetu, *Tel.;* Nag phul, *H.*

A large shrub, with yellow, often spinescent branchlets, small ovate or obovate entire or lobed obtuse leaves narrowed into a short slender petiole and yellow fls. 1·5" long in short tomentose racemes.

Fls. *April—June.*

Dhaba Forest, S. Ch. The specimen was collected by a native collector with above locality. It is, however, often grown in gardens.

Vitex Negundo, *L.*

A large strongly-scented shrub, 5—12 feet covered with a fine hoary tomentum, with digitately 3—5-foliolate leaves, acuminate leaflets and small white or lavender-coloured fls. on the short cymose branches of oblong panicles 2—8" long.

Fls. and Fr. *May—August* and at other times. Evergreen.

Frequent in waste ground, near river banks, etc.

Var. incisa, with the leaflets cuneate serrate or sub-pinnatifid is scarcely worthy of even varietal rank. It occurs near Balaghat with the normal form.

Used as a stomachic.

Vitex leucoxylon, *L.f.* Narda, *Mar.*

A large shrub or a m. s. tree, with dark bark, pubescent or silky shoots, 3—5 foliolate nearly glabrous leaves. Lflts. lanceolate 1—4·5" by ·3—1·5" acute or acuminate entire or (in very young plants) serrate, dark, shining above, paler beneath, often hairy on each side of the midrib. Petiole 1—3". Petiolules ·5—1." Fls. white-lipped ·5" across in divaricate dischasial axillary long peduncled cymes. Drupe ·5—·7".

Fls. *March—June* and *October* (perhaps all the year round).

Evergreen. (?)

Along rocky river banks, N. and S. Ch.; Laon range and S. Sihawa (Rai.); Bori (N. W.); Baghnadi (the boundary of Bhandara and Khairagarh).

(Witt says in his Behar list "a large deciduous tree with white bark and wholly glabrous leaves." I think that this must be another species.)

Vitex peduncularis, *Wall.* Morphai, *Tel.*

A tree (of small size in the C. P.) with a light-yellow blaz turning darker on exposure and light-brown in centre. Shoots pubescent with constantly 3-foliolate leaves well distinguished when young by the winged petiole. Leaflets narrowly elliptic or lanceolate 3—7" acuminate glabrous concolorous. Petiole 1·5—3", petiolules ·25". Panicles narrow oblong 6—11" long, cymose lateral branches 1" or less.

Fls. *May-June.* Fr. *August,-Sept.* Evergreen.

Valleys and shady sides of hills, rare. Salebhat nala, Sihoa (Rai.); Mater Tugu nala, Sironcha (S. Ch.).

The wood is used for yokes in Chota Nagpur.

Vitex altissima, *L.f.*, with the same vernacular name, and the leaves pubescent beneath occurs (f. Donald) in Cherla.

As no specimen of the Sironcha 'Morphai' was collected, it may have been of this.

Clerodendron Phlomidis, *L.f.* Safed tekar, *Mar.*

A large shrub with somewhat hoary pubescent, usually drooping shoots, puberulous ovate or sub-rhomboid crenate-serrate, dentate, or sub-entire leaves usually about 2″ by 1·5″ (but very small ones occur near the panicle, and the large ones attain 3·5″ by 3·5″) and axillary and terminal cymose panicles of white fls. ·75″ diameter with the tube ·75—1″ long.

Fls. *Sept.—Jany.* Also *April* (perhaps all the year).

Common in the village hedges.

Var. **Donaldi,** Kala tekar, *Mar.*

" A semi-scandant shrub or small tree, found in moist localities in the forests."—*Donald* (in Working Plan List).

Mr. Donald distinguished this variety by the leaves attaining 3·25″ (while those of 'safed tekar' only reach 1·75″), glabrous, membranous, with a cuneate base (type pubescent on both sides). Calyx ·25″ in flower and enlarged calyx as long as lobes of fruit only, which is ·3″ long (in 'safed tekar' the sepals are acuminate and are at least ·12″ longer than the fruit), glabrous, deltoid apiculate. Corolla ·75″ long.

The plant would thus appear very distinct. The 'safed takar' is used in native medicine but not the 'Kala tekar," S. Ch.

Clerodendron serratum, *Spreng.* Barangi, *H.*; Duma, *Chh.*

An irregularly branched perennial shrub or, after being burnt, with tall, straight annual sub-herbaceous stems 3—6 feet high from the rootstock, with opp. or 3-nate sub-sessile coarsely serrate leaves 3—6″ long and large pubescent panicles of blue (sometimes white) fls. 1″ or more across with the tube ·3—·5″.

Fls. *April—Nov.* Fr. *May—Dec.*

Common in valleys in all divisions.

Clerodendron infortunatum, *Gaertn.*

A robust shrub or undershrub, 4—6 feet, with densely fulvous-hairy branches, large ovate, usually cordate leaves 4—8″ long and

broad and large terminal 3-chotomous corymbose panicles of white and pink fls. 1" diameter. Conspicuous in fruit from the large red calyces.

Fls. *Feby.–May.* Fr. *May–July.*

In shady forests. Lormi and Pantora ranges (Bil.).

Caryopteris Wallichiana, *Schauer.*

A laxly-branched tall shrub, 6–15 feet, with grey bark peeling off in thin longitudinal strips. Blaze pink. Branches 4-angled sub-tomentose Leaves lanceolate 2—4 long. Easily recognised by the numerous yellow glands and the spreading blue and white, or lilac fls. in small cymes which are arranged in narrow axillary and terminal thyrses (somewhat as in Clerodendron serratum).

Fls. *Dec.—March.*

Near rivers, Laughar (Bal.).

Symphorema polyandrum, *Wight.* Chitki, *Mar.*; Tapa Thonda, *Gond.*

A large scandent or scrambling shrub with ovate villous coarsely toothed leaves 4—5" long (reaching 8—9"). Easily recognised in flower by the clusters of grey-tomentose involucral leaves surrounding a (usually) 7 fld. head of white fls. with a 10—16 partite corolla and exserted stamens. Calyx ·25—·3" long, corolla tube and petals each ·25—3 long.

Fls. *March-April.* Deciduous at the same time.

Not uncommon. Laon range (Rai.), Dhaba range (S. Ch.), etc.

NEW INDIAN SPECIES OF FOREST IMPORTANCE.

In the *Indian Forester* for September 1913, pp. 413—420. Mr. Hole published a list of trees, shrubs or woody climbers described since 1906, the year in which *Indian Trees*, by Sir D. Brandis, appeared. The following list gives the species published during 1913, together with the omissions in Mr. Hole's list which have been noticed since it was prepared. This list has been checked with the fourth supplement of the *Index Kewensis* (1906—1910), so that it is probably complete up to the year 1910. I contains a few species described during the period between the publication of Hooker's *Flora of British India* and Brandis' *Indian Trees*, but which are not mentioned in the latter. These have been noticed incidentally, but a systematic checking of *Indian Trees* Hooker's *Flora of British India* and the *Index Kewensis*, remains to be done and this will probably bring many more such omissions to light, as the third supplement of the *Index Kewensis* was not published till 1908:—

LIST NO. 2 *(to 1913 inclusive).*

Agapetes Lacei, Craib. (Kew Bull. 1913, p. 43), Burma.

Agapetes oblonga, Craib. (l. c., p. 43), Burma.

Ailanthus Wighti, Van Tiegh (Ann. Sci. Nat. Sér., IX 4, 1906, p. 279), India.

Argyreia coonoorensis, Smith and Ramas. (Rec. Bot. Surv. Ind., VI 2, 1913, p. 30), S. India.

Balanites indica, Van Tiegh. (Ann. Sci., Nat. Sér., IX 4, 1906, p. 252), India.

Balanites Jacquemonti, Van Tiegh. (l. c., p. 252), India.

Bauhinia Meeboldii, Craib. (Rep. Spec., Nov. IX 1913, p. 392), Upper Burma.

Beaumontia longituba, Craib. (Rep. Spec., Nov. IX 1913, p. 393), Manipur.

Berbersi Duthieana, C. K. Schn. (Bull. Herb. Boiss. Sér, 2, 1908, p. 200), Nepal.

10 **B. Edgeworthiana,** C. K. Schn. (l. c, p. 263), Simla, Jaunsar.

B. Griffithiana, C. K. Schn. (l. c. 1905, p. 403), E. Himalaya.

B. Huegeliana, C. K. Schn (l. c., p. 451), Kashmir.

B. Jaeschkeana, C. K. Schn (l. c, p. 399), Kashmir, Kumaon.

B. Koehneana, C. K. Schn. (l. c, p. 814), Kumaon.

B. kumaonensis, C. K. Schn. (l. c., p. 397) Kumaon

B. Zabeliana, C. K. Schn (l. c, p. 667), Kashmir.

Borthwickia trifoliata, W. W. Smith (Pro. Bot. Soc., Edinb., XXIV, pp. 173—175, 1913), Sikkim.

Bridelia cinerascens, Gehrm. (in. Engl. Bot Jahrb., XLI, Beibl 95, 31, 1908), India.

B. cuneata, Gehrm. (l. c., p. 34), Sikkim, Assam.

20 **B. Roxburghiana,** Gehrm. (l. c., p. 30), India.

B. sikkimensis, Gehrm. (l. c, p. 34), Sikkim, Assam.

B. squamosa, Gehrm. (l. c., p. 30), India.

Buxus papillosa, C. K. Schn. (Illustr. Handb. Laubholzk. II (1907), p. 139), N.-W. India.

Caragana catenata, Kumarow (Act. Hort. Petrop. XXIX (1909), p. 307), Afghanistan, India.

C. brevifolia, Kum. (l. c., p 211), Kashmir.

C. Praini, C. K. Schn. (Bull. Herb. Boiss. Sér, 2 (1907), p. 313), India.

C. sukiensis, C. K. Schn. (l. c.) U. P., Himalaya.

Cayratia sonneratii, Gagnep (Notulæ System. I 12, p. 357), India.

Corylopsis manipurensis, Hemsl. (Hook. Icon. IX tab., 2820), Manipur.

30 **Craibiodendron Mannii,** Smith. (Notes Roy. Bot. Gard, Edinb. XXIV, pp. 157—160, 1912), Assam.

Cryptocarya procera, Talbot. (For. Fl., Bomb. II (1911, p. 385), Bombay.

Cyclea Meeboldii, Diels. (in. Engl. Pflanzenreich, Menispermac. 1910, p. 315), India.

C. Wallichii, Diels. (l. c., p. 315), India.

C. Wattii, Diels. (l. c., p. 320), India.

Daedelacanthus ciliatus, Craib. (Kew Bull., 1913, p. 202), Upper Burma.

Daphne Sureil, Smith and Cave. (Rec. Bot. Surv, Ind. VI. 2. (1913), p. 51), Himalaya.

Dillenia Bailloni, Pierre. (Engl. et. Prantl. Pflanz. III 6, p 128), Sikkim, Chittagong.

Dioscorea vexans, Prain and Burkill. (Journ. As. Soc., Beng, n s. IV (1908), p. 456), Andamans.

Elæagnus Griffithii, Servettaz (Bull. Herb. Boiss VIII 1908 p. 385), East Bengal.

40 **E. indica,** Serv (l. c., p. 393), India.

E. Maximowiozii, Serv. (l. c.), East Bengal.

E. Schlechtendalii, Serv (l c., p. 389), Assam

Embelia Rodgeri, Smith. (Rec. Bot. Surv, Ind., VI 2, p. 29, 1913), Burma.

Ficus Krishnæ, C. DC. (Bot. Mag tab., 8092), India.

Flemingia angusta, Craib. Kew Bull., 1913, p. 41), Burma.

Flemingia Lacei, Craib (l. c), Upper Burma.

Fraxinus micrantha, Lingelsheim. (Engl. Jahrb., XL, 1909, p. 217), Himalaya.

F. Paxiana, Lingelsheim (l. c., p. 213), Himalaya.

Goniothalamus Meeboldii, Craib. (Rep. Spec. Nov. XII, 1913, p. 391), Burma.

50 **Gymnosporia konkanensis,** Talbot (For. Fl., Bomb. I., 1909, p. 280), Bombay.

Henslowia Collettii, Gamble. Kew Bull., 1913, p. 47), Upper Burma

Henslowia shanensis, Gamble. (l. c., p. 48), Upper Burma.

Homalium bhamoense, Cubitt and Smith. (Rec. Bot. Surv., Ind., VI 2., p. 36, 1913), Burma.

Hyphæne indica, Becc. (Agri Colon. II., 173 (1908), India.

Illicium manipurensis, Watt. (Ex. King Ann. Bot. Gard., Calc., 1891, p. 200 tab, 40 B, Burma.

Isonandra Alphonseana, Dubard. (Bull. Mus. Hist., Nat. Paris, XV., 1909, p 29), India.

Isonandra compacta, Dubard. (l. c., p.28), India

Juglans Duclouxiana, Dode. (Bull. Soc. Dend. de France, 1906, p. 81), N.-W. Himalaya.

J. Kumaonia, Dode. (l. c, p. 86), Kumaon.

60 **J. fallax,** Dode. (l. c., p. 89), Baluchistan.

J. sigillata, Dode. (l. c., p. 94), Sikkim.

Lantana malabarica, Hayek. (Fedde, Rep. Spec. Nov. II 2, 163), India.

Leea Talboti, King. (ex Talbot For. Fl., Bomb. I (1909), p. 329), Bombay.

Lespedeza dubia, Schindler. (Fedde Rep. Spec. Nov., p. 514), Garhwal.

L. indica, Schindler. (l. c.), N.-W. India.

L. Meeboldii, Schindler. (l. c.), N.-W. India.

Lettsomia Mayo, Smith. (Rec. Bot. Surv., Ind., VI 2, p. 38, 1913), Burma.

Leycesteria Belliana, W. W. Smith. (Pro. Bot. Soc. Edinb., XXIV, p. 173–175, 1913), Sikkim.

Lonicera myrtilloides, Purpus. (Mitheil. Deutsch. Dendrol. Ges., 1907, p. 225), Himalaya.

70 **Lonicera Robertsonii,** Gamble. (Kew Bull., 1913, p. 264), Upper Burma.

Lonicera vaccinioides, Rehder. (Fedde Rep. Spec. Nov. II, 1906, p. 66), India.

Loranthus Meeboldii, Gamble. (Rep. Spec. Nov. XII, p. 34), Burma.

Loranthus Robertsonii, Gamble. (Kew Bull., 1913, p. 44), Upper Burma.

Mastixia Meziana, Wangerin. (Fedde Rep. Spec. Nov. IV, 1907, p. 335), India.

Micholitza obcordata, N. E. Br. (Kew Bull., 1909, p. 358, and 1910, p. 201), Upper Burma.

Mimusops andamanensis, King and Gamble. (Journ. As. Soc., Beng., LXXIV, 2 (1906), p. 201), Andamans.

Oianthus deccanensis, Talbot. (For. Fl., Bomb., II (1911), p. 260), Bombay.

Osyris divaricata, Pilger. (Bull. Herb. Boiss. Sér. 2 VI (1906), p. 104), Baluchistan.

Pericampylus Prainianus, Diels. (in Engl. Pflanzenreich, Menispermac. 1910, p. 221), India.

80 **Phæanthus moulmeinensis**, Craib. (Rep. Spec. Nov. XII, (1913), p 392), Burma.

Photinia birmanensis, C. K. Schn (Illustr. Handb. Laubholzk, I (1906), p. 709), Burma.

Prunus anadenia, Koehne. (Fedde Rep. Spec Nov. IX. p. 34), Afghanistan, Himalaya.

Prunus bracteopadus, Koehne. (l. c, p 33), Assam, Burma.

Prunus glaucifolia, Wall. (ex Koehne, l. c, p. 35), Himalaya.

Pueraria quadristipellata, C. B. Clarke. (ex Smith in Rec Bot. Surv., Ind., VI 2 1913), p. 36), E. Himalaya.

Ribes tenue, Janczewski (Bull. Acad. Cracovie (1906), p. 290), Himalaya.

Rourea breviracemosa, Gamble. (Kew Bull, 1913, p. 187), Southern Shan States

Rourea Prainiana Talbot. (For. Fl, Bomb., I (1909), p. 368), Bombay.

Scolopia Closii, Gagnep (Journ. de Bot., XXI (1908), p 167), India.

90 **Sorbus cashmiriana**, Hedlund. (Svensk. Vet. Akad., Handl. (1901), Vol. 35, p. 35), Kashmir.

Sorbus Hedlundi, C. K Schn (l.. Handb. Laubholzk, I (1906), p. 676), Himalaya

Sorbus rufopilosa, C. K Schn (Bull. Herb Boiss. Sér. 2, VI. 1906, p. 317), Sikkim.

Stauntonia elliptica, Hems.. (Hook. Icon., IX, tab, 2844), Assam.

Stauntonia filamentosa, Griff (Hook. Icon., IX, tab., 2845) (et Notulæ, 1854, Vol. IV, p. 334), Assam

Stephania andamanica, Diels (in Engl. Pflanzenreich Menispermac. 1910, p 266), Andamans.

Sterculia principis, Gagnep. (Notulæ System. I, 3, p. 82), Burma.

Strychnos Thorelii, Pierre. (Bull Soc. Bot. de France, X, 1910, p. 20), Burma.

Taxotropis triapiculata, Gamble. (Kew Bull., 1913, p 188), Southern Shan States.

Thunbergia Lacei, Gamble. (Kew Bul., 1913, p. 116), Burma.

100 **Tinomiscium micranthum**, Diels. (in Engl. Pflanzenreich, Menispermac. 1910. p 116), Assam

Tinospora andamanica, Diels (l c, p 141), Andamans.

Tinospora Mastersii, Diels (l c. p. 140), Assam.

Viscum costatum, Gamble. (Kew Bull., 1913, p. 46), N.-E Himalaya.

Viscum trilobatum, Talbot. (For. Fl., Bomb., II, 1911, p. 419), Bombay.

Vitex carbunculorum, Smith and Ramas. (Rec. Bot. Surv., Ind., VI, 2, p. 31), Burma.

Walsura Perrottetii, C. DC. (Ann. Conserv. et Jard. Bot., Genève, X (1907), p 152), India.

Wrightia Aplinii, Craib. (Kew Bull. 1913, p. 44), Upper Burma.

Wrightia Lacei, Craib (l. c., p 144), Burma.

DEHRA DUN: }
25th April 1914.

R. N. PARKER,
D. C., Forests.

A NOTE ON THE CHEMICAL COMPOSITION OF THE FRUITS OF *DILLENIA INDICA.*

On an enquiry made by Rai Bahadur Upendra Nath Kanjilal in May 1912, the chemical examination of the fresh ripe fruits of *Dillenia indica* was undertaken by the writer under the instructions of the Chemical Adviser, with a view to identifying the acid present in the fruits and ascertaining if the fruits could be utilised for the manufacture of any commercial article.

The same enquiry was again made by the Divisional Forest Officer, Lakhimpur, through the Forest Economist in 1913.

The fresh ripe fruits were taken and the upper layers of calyces were separated from the inner kernels which consisted mostly of pectous matter of a jelly-like consistence. The kernels being rejected, the calyces were crushed and steeped in 90 per cent. alcohol for six months in a drum with occasional shaking. The alcohol was then filtered off and the residue was pressed almost dry, and this alcohol was added to the first and the whole evaporated off under reduced pressure. The alcoholic extract was finally dried at 100° C. for further examination.

The composition of the calyces of the fresh ripe fruits was as follows:—

Moisture	86·40	per cent
Alcoholic extract	3·00	,,
Water extract	0·37	,,
Insolubles	10·23	,,
	100·0	,,

The aqueous extract was made after having extracted the calyces with alcohol, which thus represents only pectous matters, etc., left in the insoluble tissues after alcoholic extraction. The alcoholic extract examined qualitatively showed the presence of tannin glucose, malic acid and pectous bodies. Malic acid was also identified by means of its lead salt. The composition of the alcoholic extract obtained as given above was as follows:—

Moisture	8·20
Tannin	1·40
Glucose	12·15
Malic acid	2·21
Petroleum ether solubles (fats, etc.)	0·72
Albuminoids	0·85
Ash	12·63
Pectous matters, etc.	61·84
	100·00

The 61·84 per cent. of pectous matters coming in the alcoholic extract is due to the dilution of alcohol caused by about 86 per cent. of moisture in the fresh fruit. Though originally soluble in dilute alcohol these bodies became wholly insoluble both in water and in alcohol on anhydration. They were examined and found to be pectous bodies.

The chief ingredients of the calyces of the fresh ripe fruits are tannin, glucose and malic acid. The percentage of these three ingredients calculated on fresh and dry calyces stand as below :—

			On fresh calyces.	On dry calyces.
(1)	Tannin	...	0·05%	0·37%
(2)	Glucose	..	0·40%	2·92%
(3)	Malic acid	...	0·07%	0·51%

From the above figures it is evident that the fruit is of no commercial use.

DEHRA DUN :
2nd March 1914.

T. P. GHOSE,
Assistant to Chemical Adviser.

MR. HAINE'S LITS OF TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN FOREST CIRCLE, C.P.,

BY R. MCINTOSH, I. F. S.

SIR,—I should like to comment on one point in connection with the list of trees, shrubs and economic herbs of the Southern Forest Circle, C. P., by Mr. H. H. Haines, now appearing in the *Indian Forester*.

In many instances the Telegu name of the tree or plant described is given, and a very limited knowledge of the Telegu language enables the reader to perceive that the knowledge of that language possessed by Mr. Haines must be even more limited.

He gives the Telegu name of *Albizzia Thomsoni* as *Kondalachetu*. This literally means the tree which grows on the hills and is not the vernacular name of any tree. The expression is an indefinite one and is used in the same way as *Adevechetu* which means jungle tree.

Similarly the Telegu name for *Pithecolobium dulce* is given as *Simchita* which is a rude form of *Semachetu* meaning the foreign tree. There is of course no Telegu name for *Pithecolobium dulce* and the expression Semachetu is applied to all exotics.

These are only instances of inaccuracies which detract from the value of (as far as I can judge) an otherwise admirable local list of trees and shrubs, and I would ask if it is not better to omit the vernacular names in cases where they are, to say the least of it, uncertain, rather than to gravely publish inaccurate matter.

CHAMBA:
14th June 1914.

R. McINTOSH, I.F.S.

EXTRACTS.

FOREST GUARDS AND SUPERIOR SERVICE.

In connection with the above we are enabled to publish the following letter from the Secretary of State for India :—

To

HIS EXCELLENCY the RIGHT HON'BLE the GOVERNOR-GENERAL in Council in India.

MY LORD,

Service of Forest Guards on pay exceeding Rs. 10 a month to be classed as superior service.

Having considered in Council your letter of the 30th January, No. 28, I sanction your proposal to class as superior the service of such grades of Forest Guards, on pay exceeding Rs. 10 a month, as may be specified by the local Governments and Administrations concerned, to whose discretion it will be left to bring the change into force when they consider it desirable to do so.

I have, etc.
(Sd.) CREWE.

POISONING BY CONIFERS.

The Board have recently received an enquiry as to whether certain species of *Cupressus* and *Abies* are poisonous. The only conifer which commonly causes poisoning of live-stock is the Yew, but injury might more frequently occur were it not for the fact that conifers generally are unpleasant to the taste, and are hence avoided by stock. Many species, however, contain *tannin, resins*, and *gums, volatile oils*, and an *acrid substance* which may cause inflammation of the digestive and urinary tracts, while Tanret found in the young shoots of *Picea* the glucoside *Picein*. It is quite possible that if eaten in quantity the foliage of some conifers may induce poisonous symptoms and even death in the animals concerned. It is noteworthy, however, that according to Pott the

needles of *Picea excelsa*, *Abies pectinata*, *Larix Europæa*, and *Pinus* sp. are, in the mountainous districts of Steiermark, Kärnten and Tyrol, extensively fed to cattle and sheep, usually as a supplementary food, either fresh or dried and ground up—chiefly perhaps as an appetiser, and in small quantities as a dietetic; *Juniperus* sp. are similarly utilised in some districts. It is not known to what extent the foliage may be fed without harmful consequences, but Pott states that large quantities can cause hæmaturia and similar effects, and hence only small quantities should be used, and even so may impart a bad flavour to the milk of cows. All green needles frequently cause digestive troubles.

The foliage of the Yew (*Taxus baccata*) is well known, in certain stages, to be dangerously poisonous to stock, and has caused many losses.

In regard to *Cupressus* the only cases of poisoning which have been traced are recorded in this *Journal* (October 1905). In one case four bullocks died, and there was little doubt that the cause of death was irritant poison. Some pieces of *C. macrocarpa* were found in their stomachs, and in default of any other explanation it was suggested that this plant might have poisonous properties.

In another instance three heifers were stated to have suffered from irritant poison; one of them died, but the other two recovered on removal to another field. The veterinary surgeon in this case attributed the death to a Cupressus (*C. nootkatensis*) growing by the side of the field.

The Board have no information as to the poisonous properties of these two species, nor can any record be found of any similar case which would tend to confirm the suspicion that they are poisonous to cattle. [*Journal of the Board of Agriculture.*]

COLORING THE WOOD OF GROWING TREES.

The darker shades in wood are so much more highly prized for ornamental purposes, that it has long been a practice to stain artificially the lighter woods, such as birch and soft pine. Some years ago a new method of coloring wood was introduced approximating natural processes more nearly and giving the effect of "aging" throughout the mass of the wood, the best results being obtained in wood containing tannin. Thus ordinary oak under certain conditions can be made to assume the rich dark hue characteristic of swamp oak or black oak. The shade, however, is variable, since the constituent elements of the wood itself largely determine the results obtained, woods which contain tannin yielding different results from those lacking this substance and resinous varying from non-resinous woods.

These facts have raised the question whether the constituents of the *living* wood, *i.e.*, of the growing timber, could not be altered in some manner. The idea was not the production of variegated wood, but the introduction into the living tree of some substance which would so penetrate the wood and produce such chemical alteration that proper treatment subsequently would give to the lumber a typical tone throughout its mass.

For example, if it were possible to impregnate such tannin-free woods as birch and maple with a tannin solution during growth, it would later be a very easy matter to give these woods a rich dark tint similar to that of the oak (which is rich in tannin) by means of treating it with ammonia under pressure.

According to *Die Naturwissenschaften* experiments in this direction were made as early as 1839, but without much success. Recently, however, Dr. Kleinstück has obtained valuable results from experiments which he describes in the *Zeitschrift fur angewandte Chemie.* He found that the wood was most successfully impregnated when the bore-hole passed entirely through the trunk of the tree. One end of this channel is stopped with cork, and into the other a tube is inserted through which the impregnating fluid flows from a suitable container In large trees a whole system of bores is made.

In the first series of experiments use was made of aniline dyes which must be soluble in water, easily diffusible and light-fast.

Thus malachite green and methylene blue were found to color birch evenly and uniformly, while eosin merely veined the wood with red.

Secondly, substances were employed which give typical reactions with the lignin of the wood, *e.g.*, paraphenylendiamin and anilin hydrochlorate. By the use of a one per cent. solution of the first salt a birch tree was thoroughly colored overnight, and after a few days the dark sheen of the leaves had been so deepened that from a distance the tree looked like a copper-beech.

The power of absorption is found to be very great. Thus, a fir drank up 10 liters of salt solution in two days. In a third series substances were experimented with, which, like tannin, gave the lumber a definite tone upon subsequent treatment.

Finally, artificial pressure from without was tried, but this failed to yield satisfactory results.—[*Scientific American.*]

Pt. Mechl. Dept., Thomason College, Roorkee

Antiseptic treatment of Chir Pine Sleepers in the Kumaun Circle, U. P.

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INDIAN FORESTER

SEPTEMBER, 1914.

ANTISEPTIC TREATMENT OF CHIR PINE SLEEPERS IN THE KUMAUN CIRCLE, U. P.

BY J. E. C. TURNER, P.F.S.

Treating centres have recently been established at Tanakpur, Hardwar and Kathgodam, on the Sarda, Ganges and Gaula rivers respectively. These three places are the floating termini for the Kumaun Circle timber. Hardwar is situated on the Oudh and Rohilkhand Railway, while the other two places are railway termini on the Rohilkhand and Kumaun Railway. It is believed that arrangements on such a large scale for the treatment of railway sleepers and miscellaneous timber have not hitherto been attempted in India and Burma. Considerable interest must therefore attach to what is now being done in the United Provinces by the "open tank method" of treatment. The accompanying photographs (Plates 11 and 12) illustrate the treatment plant in course of construction and the preparation of the yard at Kathgodam.

The structure will consist of a unit of six tanks, each to be let down into a masonry-lined shell, the lower section of which is so constructed that the tank when finally placed in position rests on supports above a brick-lined fire-place. Along the back

of the underground structure is a continuous pit, each fire-place being connected with it by a stoke hole. This pit ensures a sufficient draught playing throughout each section. In front of each shell will be noticed a square-shaped hole; an underground flue joins them; an iron chimney with a plate will be held in position by holding-down bolts, the heads of which, with nuts attached, are noticeable just above the masonry. The bricks in the fire-places are so arranged that it will be possible to reverse them when their present exposed surfaces show signs of wear and tear.

The superstructure rests on stone masonry pillars capped with galvanised iron sheets. In each of these pillars there is a strong holding-down bolt with an anchor plate buried nearly six feet in a well-built foundation. These bolts project sufficiently above the pillars to receive the horizontally placed sleepers to which are fastened the feet of the trestles by suitably shaped iron bars bolted through the timber. The photograph best describes the other component parts of trestles and the manner in which they have been put together. It must be mentioned that the trestles are built of B. G. chir sleepers, and sawn sections, a step that effected much economy. The roof will consist of corrugated iron sheeting fixed to the purlins by angle cleats, limpet washers being introduced above.

Spur-geared chain pulley blocks will be suspended from the main longitudinal beams. Two of these are seen in position. Their function will be to raise and lower the crates in each of which will be packed a charge of twenty sleepers. These pulley blocks proved of immense use in lowering the large treatment tanks satisfactorily into the masonry-lined shells. The tanks arrived a day or two after the photographs had been taken.

The second photograph shows the whole yard. A 2-ft. gauge tramway has been laid from the roadway of the Rohilkhand and Kumaun Railway up to the masonry-lined shells to facilitate the bringing up of the treatment and storage tanks as well as the crates. Unloading has thus been done direct from the railway wagon on to the tramway truck.

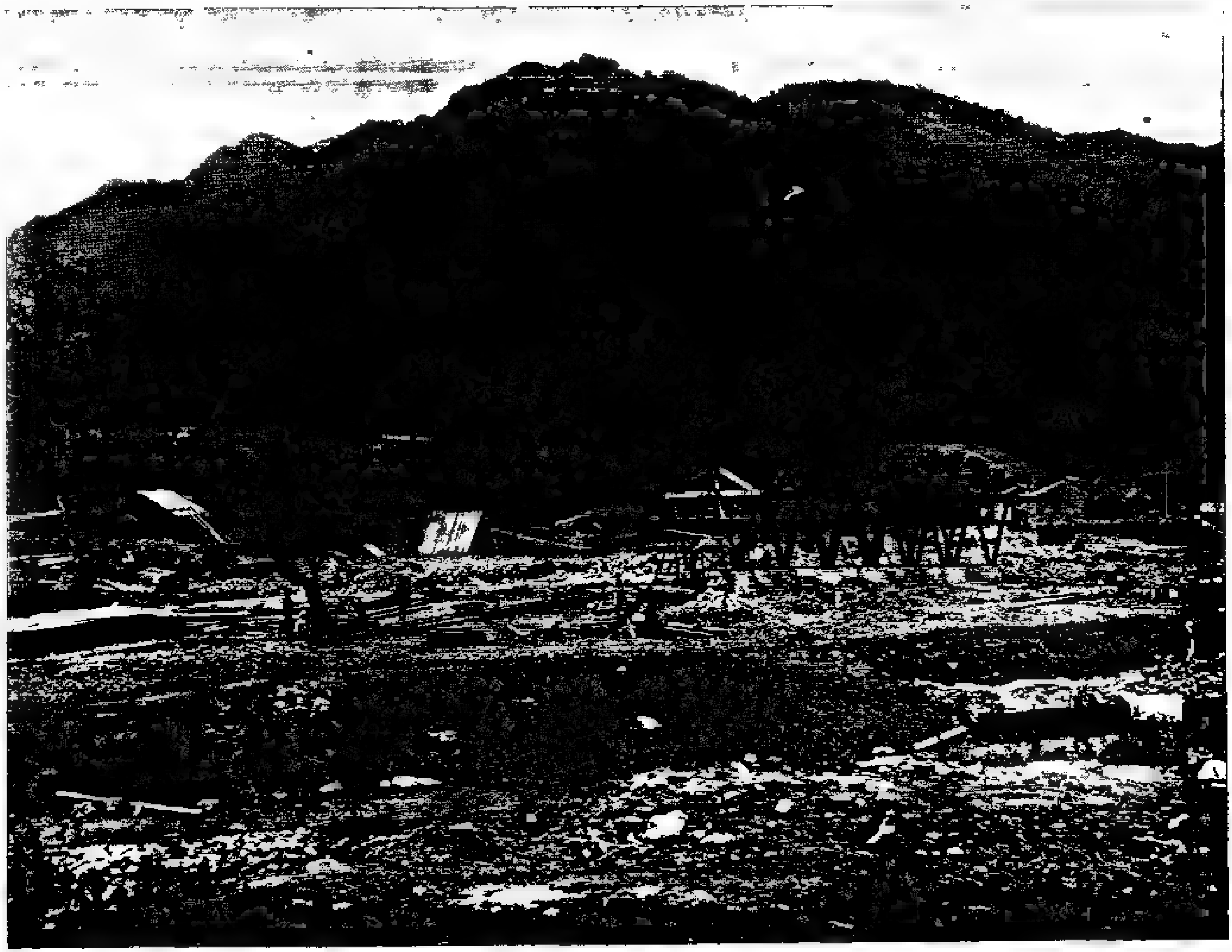

Photo Mech. Dept., Thomason College, Roorkee.

Antiseptic treatment of Chir Pine Sleepers in the Kumaun Circle, U. P.

The platform seen in the foreground is meant for storing drums of oil and to enable them to be unloaded at once on arrival. A special siding for the Forest Department has been put in by the Rohilkhand and Kumaun Railway and runs along the foot of the platform. The oil from these drums will be pumped up to the storage tanks whence it will be run through pipes by gravity to the treatment tanks as required. As seen in the photograph the platform is incomplete ; a breast-wall is being built

It is unnecessary to go into detail regarding the method of treatment and the principle underlying it, as the subject has already been fully dealt with in a recently issued pamphlet by Mr. R. S. Pearson, Forest Economist.

The plant was designed by *Mr. R. S. Underhill, Forest* Engineer.

LIST OF THE TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN FOREST CIRCLE OF THE C. P.

(PART VII.)

BY H. H. HAINES, I.F.S.

[*Continued from the "Indian Forester" for August* 1914.]

LII.—LABIATÆ.

Pogostemon plectranthoides, *Desf.*

An aromatic undershrub, sometimes attaining 6 ft. high with 4-sided branches, large ovate coarsely crenate leaves about 4·5″ by 3·5″ and small white fls. conspicuous from the light purple stamens. Fls. in dense sub-capitate 1-sided bracteate cymes which are secund on the branches of a large panicle.

Fls. *January—March.*

In damp localities, frequently gregarious. Very abundant in parts of Pandratolah forest (Bal.); Bh.; S. Ch.; Bil.; Sihoa forests (Rai.).

Colebrookia oppositifolia, *Sm.*

A large spreading soft shrub 5—10 feet with stout whitish branchlets, large white-tomentose crenate, sometimes ternate,

or obtuse at both ends, glabrescent except sometimes on the nerves, 3—9·5″ long, and slightly aromatic. Petiole slender. Fls. greenish, small in small corymbose umbels. Fr. black shining globose ·3′ diam. on the slightly enlarged perianth tube.

Fls. *June—July*. Fr. *Oct.—Nov.* Evergreen. New shoots in May.

Widely spread but not common. In valleys. Rai.; Bal.; S. Ch.; Bil.; Nishani hill forest (Bh.).

Litsæa polyantha, *Juss.*

A small tree with smooth bark and blaze, a mixture of brown and white, brown pubescent branchlets, strongly nerved ell.- or oblanceolate-oblong obtuse or sub-acute leaves 4·5—9″ long, pubescent and glaucous beneath with 7—12 prs. strong sec. n. and raised parallel cross nervules. Fls. small greenish, with usually 5 linear sepals, in stout peduncled umbels which are axillary and clustered along the branchlets. Fr. ·25—·5″ long, seated on the shallow saucer-shaped perianth base.

Fls. *March—May* Fr. *July—Aug.* Evergreen. Leaves renewed in *May*.

In valleys, especially near flowing streams, rare. Sihoa forests (Rai.); Lormi forests (Bil.); Katonda (N. Ch.).

Cassytha filiformis, *L.* Amarbel, Adharbel, *H.*

A filiform leafless glabrous or pubescent parasite attaching itself by means of haustoria to Sal, Carissa and other bushes, resembling Cuscuta (q. v.) but dark green in appearance. Fls. green or white (when fully out), under ·1″, sessile in spikes ·5—1·5″ long with 3 broad ovate imbricating bracts at the base. Fr. small globose crowned by the perianth lobes.

Fls., Frt. esp. *Sept.—Dec.*

Very common in S. Ch.; N. Ch.; less common in other districts. It is noteworthy that the Cassytha and Cuscuta are seldom found in the same localities.

LIV.—LORANTHACEÆ.

Loranthus longiflorus, *Desrouss.* Moheka bandha, *H.*; Tunki bajania, Wajinika, *Tel.*; Hitili, *Gond.*

A large parasitic shrub with very variable coriaceous usually sessile glabrous leaves 3—6" long or more and pink or scarlet fls over 1" long in axillary and terminal racemes.

Fls. *Feby.—April.*

Common in all divisions on Mohwa, Boswellia, etc. [The pink fld. form is very common in Raipur. Were it not for the innumerable varieties of this plant, it could be ranked as a distinct species. The young leaves are green not red, sessile and amplexicaul, ovate or oblong-ovate. Racemes hoary. Anthers shorter than the filaments. Cor. puberulous. It fls. after the red one is in fruit.]

Loranthus Scurrula, *L.*

A tufted parasitic shrub, young parts with a brown or white furfuraceous tomentum. Leaves ovate oblong or elliptic 2—4", mature sometimes glabrous. Fls. in contracted racemes, green, under ·5" long with bright red filaments. Fr. clavate.

Fls. *Nov.—Jany.* Fr. *Dec.—March.*

On Woodfordia, Combretum, Wendlandia and other trees. Rai.; Bil.

Viscum orientale, *Willd.* Bandha, *H.*; Gurbel, *Gond.*

A parasitic shrub with terete 2—3-chotomous or sub-verticellate branches, obovate or ell.-oblong sub-sessile 3-nerved leaves about 1·5 by ·6" or less with a mat surface and small yellowish flowers under ·1" long, sessile in axillary and terminal fascicles. Fr. ·25" diam.

Fls. *Feby.—June.* Fr. *Nov.* (and other times).

Raipur; Chanda. On Zizyphus, etc.

Viscum articulatum, *Burm.*

A leafless parasitic shrub with sap-green straite often subverticellate flattened branches contracted at the nodes.

Fls. *Dec.—Jany.*

All divisions chiefly on Diospyros.

LV.—SANTALACEÆ.

Santalum album, *L.* Chandan, *H.*

A small glabrous evergreen tree, a hemi-parasite on roots. L. opp. 1—2·2" long ell.- or ovate-lanceolate. Fls. small purple in terminal 3-chotomous panicles, ·17" diam. Fr. globose shining black.

Fls. *March.* Fr. *Nov.*

Introduced into N. Chanda and S. Chanda forests where it is growing fairly well, and reproducing itself in N. Chanda.

LVI.—EUPHORBIACEÆ.

Euphorbia Tirucalli, *L.* Newaranga, *Mar.*

A large shrub or small tree up to 25 ft. high with milky juice and erect green quill-like leafless branches, or leaves very small and caducous.

An introduced plant, common in village hedges, especially (*e.g.*, about Chorkamara) in Bhandara.

Euphorbia nivulia, *Ham.* Kothuthuwa, *Mar.;* Jepada, *Tel.* (Syn. E. nereifolia, *Roxb.* and *Cooke.*)

A tree 15—30 ft. high with thick rugose corky bark below (when old), and spreading often whorled fleshy branches. Branches thick terete with flat brown or black corky areas bearing 2-stipular thorns ·25 –·3" long. Rarely on depressed tubercles. L. obovate or oblanceolate to spathulate-obovate, 4 to 9", with rounded or slightly retuse tip. Fls. in fleshy involucres usually 3-nate in peduncled cymes from the leaf scars and near the ends of the branches. Anthers purple or red didymous retuse, not at all apiculate, dehiscence oblique.

Fls. *Feby.—April.* Fr. *April.* Leafless *Feby.—June.*

Usually in rocky places. Sometimes under cover where the rocks are near the surface. In all divisions.

Euphorbia nereifolia, *L.* (not of Roxb.) Syn. E. ligularia, *Roxb.*

A large branched shrub or small tree 6—15 ft. high with milky juice and sharp stipular thorns on sub-confluent tubercles

arranged in 5 vertical or spiral lines. Leaves narrowly obovate or obovate-oblong. Involucres or receptacles much as in the last (the first are male and bear two ovate-lanceolate bracts at the base of the short pedicel. In the axils of these arise two turbinate receptacles bearing female fls. and again subtended by a pair of bracts, the ultimate cymes are 3-chotomous). Anthers apiculate, dehiscence longitudinal.

Fls. *Feby.—March.* Deciduous *March—June.*

Common in village hedges, etc., but not seen wild. This is also the case in Bengal.

[*Note*.—Cooke follows Roxburgh in the nomenclature of these two species, but the Linnean species is quite clearly described as "Euphorbia aculeata seminuda, aculeis geminatis *angulis oblique tuberculatis* superne foliosis" and Linnæus quotes Commelin's figure which exactly agrees with his description. Roxburgh states that Linnæus called both species 'nereifolia' but he does not appear to have seen Commelin's figure.]

Euphorbia caducifolia, *Haines.* (*Ind. Forester*, No. 4, p. 154, 1914.)

A shrub with milky juice and numerous erect fleshy jointed stems from the root 3—5 ft. high, unbranched, smooth and terete below, above with black tipped tubercles bearing a pair of slender stipular thorns ·25" or less long, soon disappearing. Leaves small, broadly ovate and crisped at the margins when young, very caducous. Involucres solitary or in short 3-nate cymes. Anthers broadly oblong, not at all apiculate, dehiscence longitudinal.

Fls. *Feby.—March.* Leaves only appear in the rains.

On sandstone rocks, Balod range, *Raipur.*

Bridelia retusa, *Spreng.* Kasai, *H.*; Kashi, *Chh.*; Katiain, *Mar.*; Kora, *Tel.*

A small, rarely m. s. tree with long conical thorns on the trunk when young. Bark grey flaky in the old trees, moderately thick with a dark crimson blaze. Leaves 4—10" stiff ell.-oblong or sometimes rather obovate, with strong parallel sec. n. and straight cross tertiaries. Fls. small greenish in axillary and spicate clusters. Fr. ·25—·3" globose, yellowish (or black when over-ripe).

Fls. *Aug.—Oct.* Fr. *Nov.—Jany.* Evergreen.

In all divisions, frequent.

A fair wood. The leaves are largely used for buffalo fodder. The fruits greedily eaten by green pigeons, parrots, etc.

Bridelia Hamiltoniana, *Wall.* Kudursi, *Mar.*

A much branched shrub or small tree with slender often drooping brown branches, glabrous (or nearly so) leaves 2—4″ pale glaucous beneath from lanceolate to broadly ovate obovate or suborbicular with 6—7 rarely 9 sec. n. each side (which are often forked near the ends in the broader leaves) and cross tertiaries. Fls. small in axillary clusters. Fr. ·25—·3″ diam. ultimately purple blue.

Fls. *Aug.—Sept.* Fr. *Oct.—Dec.*

Dry stony places and quartzite and sandstone rocks. Common in N. and S. Chanda ; Laon range (Rai.).

Cleistanthus collinus, *Benth.* Garari, *Mar.* ; Korsi, *Tel.*

A small or m. s. tree (large, attaining 6 ft. girth, in Allapalli, *Donald*) with blackish rough bark and red blaze, distichous orbicular, obovate or broadly elliptic leaves 1—4″ glaucous glabrous beneath. Fls. axillary green or yellowish ·25—·3″ diam. males clustered, fem. often solitary sessile. Capsules chestnut coloured shining, ·75″ diam.

Fls. *April—May.* *Fr. following March—April.* Leafless *March—April.*

One of the most generally used trees for poles and fences, very durable and not attacked by white-ants. All parts more or less astringent and poisonous. An excellent coppicer.

Phyllanthus Emblica, *L.* Aonla, *H.* *Mar.* ; Nelli, *Gond.* ; Usirki, *Tel.*

The fruit is the Emblic Myrabolan.

A small or m. s. tree with whitish-grey smooth bark, pink blaze and distichous close-set small linear-oblong leaves ·3—·75″ long, the branchlets closely resembling pinnate leaves and lateral often deciduous. Fls. minute yellowish densely fascicled in the axils of

the new leaves. Fr. globose succulent ·75" diam. with a 6-ridged stone.

Fls. *Feby—May*. Fr. *Oct.—April*. (Often ripe in Oct.). Deciduous *March—April*.

Common in all divisions. The wood is fairly good The fruit makes an excellent preserve.

Phyllanthus distichus, *Muell.* Star gooseberry.

A glabrous tree with pinnately distichous leaves 1—3' and globose lobed fleshy fr. with 3—4 celled putamen is cultivated in gardens.

Phyllanthus Lawii, *Grah.*

A shrub with numerous erect rigid stems 3—4·5 ft. high, close spreading slender branchlets with distichous crowded sub-sessile small leaves ·25" long and solitary or few minute pinkish fls. in their axils. Fr ·12—·17" diam.

Fls. and Fr. *Jany.—March.*

Often gregarious along the banks of rocky rivers with a constant water supply. Throughout the circle.

Numerous other small species of Phyllanthus occur with woody bases to their stems, or annuals.

Kirganelia reticulata, *Baill.* Syn. Phyllanthus reticulatus, *Poir.* Pitouri, *Mar.*; Pulser, *Tel.*

A scandent or sub-erect shrub with usually sarmentose pubescent branches, the subtending bract of a twig and its two stipules are sometimes converted into recurved thorns L. ·5—1·75" rarely 2", pinnately arranged, elliptic or oblong glabrous or pubescent with 6—8 sec. n. each side. Fls. small green campanulate usually 1 male and 1 female, axillary or sub-racemose. Berries small, black, ·2 diam

Fls. *Dec.—May.* Fr. *Feby.—June.* More or less, deciduous.

Common in hedges along valleys, etc., in all divisions.

Very variable. An erect form, very pubescent, with orbicular or broadly elliptic leaves 5 and with 3—5 sec. n. only occurs in N. Ch.

Glochidion lanceolarium, *Muell.*

A small glabrous tree, or flowering as a shrub, with grey striate smooth bark, delicate pink blaze, reddish wood, green rather flexuous and angular twigs, glabrous dark green shining leaves and small axillary fls, the females green campanulate 1—3 or more together sessile, the males yellowish ·12—·25″ diam. numerous, on capillary pedicels 2—·75″ long. Capsule orbicular depressed lobed ·6—·75″ diam. and ·5 6″ long.

Fls. *March—May*. Fr. *Sept. Jany.*

New shoots in March.

Chiefly in valleys near streams. Lormi forests (Bil.) rare.

This is the extreme western limit of distribution of this species in this latitude.

Glochidion zeylanicum, *A. Juss.* Arwi-ganer Chetu, *Tel.*; Recha, *Mar.*

A small tree with dark bark, shining ovate, ovate-lanceolate ell.-oblong or oblong-lanceolate leaves mostly 4—6″ but attaining 9 by 3·75 with rounded or cordate often unequal base and acute apex, 5—8 sec. n. each side, short stout petiole and small subulate hardened stipules ultimately deciduous. Fls. in axillary or extra-axillary sub-sessile or *stalked* clusters. M. and F. in same clusters M. ·25″ diam. yellowish, green or reddish, on pedicels ·25″ long.

Fr. ·25—·3″ diam. depressed globose, epicarp not lobed, beaked by the style, rupturing before the deeply 5-lobed endocarp.

Fls. *March—May.* Fr. *Nov.—Dec.*

Along streams. Moharli range (N. Ch.); Ahiri; Dabatota and Sironcha (S. Ch.).

Glochidion velutinum, *Wight.*

A small tree with all parts pubescent or tomentose. Bark brown and rough. Blaze crimson. L. ell.-oblong or oblong-lanceolate with usually somewhat unequal cuneate base, rarely ovate or with sub-cordate base, 3—6·5″, with 4—7 prs. strong sec. n. and cross tertiaries. Petiole ·25″. Stipules persistent subulate. Fls. axillary solitary and clustered. M. yellow on pedicels ·25—5″. F.

green, pedicels ·1″ capsule ·3″ diam. depressed pubescent lobed, usually sub-sessile.

Fls. on new shoots *April—May*.

In all divisions. Common on the plateaux in Balaghat and in Bilaspur, elsewhere scattered.

The wood does not appear to be used.

Flueggia microcarpa, *Blume*. Kudursi, Vorpithoni, *Mar.*; Dengala, *Chh.*

A glabrous straggling shrub attaining 12 feet, with light-coloured bark, thin elliptic or more often obovate or orbicular leaves 1—3″ long glaucous beneath with 4—8 slender sec. n. each side usually raised beneath and slender petiole ·12—·25″. Fls. minute or capillary peduncles ·17—·25″ long in axillary clusters. Fr. either with white fleshy epicarp ·3″ diam. or dry ·12—·17″ diam.

Fls. *May—Aug.* Fr. *July—Sept.* Evergreen. New leaves in *May*.

In all divisions. Common in the moister valleys of South Chanda and Raipur.

Putranjiva Roxburghii, *Wall.*

A handsome m. s. tree with drooping branches, bifarious broadly lanceolate leaves 1—3·5″ inclined forwards, often with a wavy or somewhat serrate margin. M. fls. in numerous minute yellow axillary heads or contracted racemes. F. fls. green 1—2 axillary with large stigmas. Drupe ellipsoid hoary ·6″ on pedicels ·5—·75″.

Fls. *March—April.* Fr. *Jany.—Feby.* Evergreen.

Amjhar Nala, Dhaba range (S. Ch.).

Antidesma Ghaesembilla, *Gaertn.* *Jhondurli, Jhondri. Mar.*; Pulser, Pulcher, Polari, *Tel*

A large shrub or small tree up to 18″ girth with broadly ell.-oblong or orbicular leaves, 2—4·5″ rarely attaining 6 by 3·5″, hoary tomentose when young, more or less pubescent or villous

beneath when old with 3—6 strong sec. n. each side; petiole ·17—·5".

Fls. minute pedicelled in densely tomentose panicled spikes ·75" to 2·5" in fruit. Fr. red. to black compressed globose to oblong ·2" seated on the hairy 5—7 fid. calyx.

Fls. *May—June* Fr. *July—Oct.* All divisions, chiefly in open forests.

Antidesma diandrum, *Roth.* Katma, *H.;* Amrol, *Chh.;* Ghondurli, *Mar.;* Sabheli Baji, Amuri, *Gond.*

A large shrub 6—12 ft. usually glabrous except the shoots, with obovate-lanceolate or somewhat rhomboidly elliptical leaves usually 1·5—3·5" rarely 5" long, acute or acuminate with cuneate base and 4—5 sec. n. each side. Fls. minute green in mostly simple spikes. M. 1—2" long. F. often 3" in fr. Fr. sub-globose, under ·2" diameter, with slightly compressed or rugose keeled stone.

Fls. *May—June.* Fr. *Nov.—Jany.* Leaves turning red *Jany.—March* before falling.

Valleys. Bh.; N. Ch.; S. Ch.; Bil.; probably in all divisions except, perhaps, Wardha. The young leaves are eaten.

Jatropha Curcas, *L.* Retanjot, *H.;* Rani Jhara, *Gond.*

A large shrub or small tree with glabrous (exc. when young) 3—5-angled or lobed leaves 4—7" diam. and small greenish yellow fls. with a campanulate 5-lobed corolla in terminal cymose panicles.

Fls. *May—Oct.* Deciduous.

Very common in village hedges. The oil of the seeds is a violent purgative and emetic.

Jatropha gossypifolia, *L.*

A shrubby plant often purple in colour, with thick branchlets, 3—5-lobed or partite leaves 3—8 diam. with the margins, long petioles, and stipules covered with glands. Fls. small, red, in terminal cymes.

Fls., Fr. r. s. Deciduous.

Common in waste ground, semi-naturalised.

Several species of Jatropha with coral-red or crimson fls. form handsome garden plants in the C. P., but require some shelter from the hot winds in April.

Codiaeum variegatum, *Blume.*, is one species of the evergreen brightly coloured shrubs termed 'crotons,' so commonly cultivated, though, on account of the dry hot winds, they will not do well in the open in the Southern Circle.

Acalypha colorata, bicolour, hispida, &c. (Vasanti, *Vern.*; Copper leaf, *Eng.*), form large handsome garden shrubs.

Acalypha indica, *L.*, and **A. malabarica,** *Muell.*, are herbaceous and occur as weeds. They are of no forest importance.

Mallotus philippinensis, *Muell.* Sinduri, Kamela, *H.*; Kuku Bacha, *Mar.*; Korku, *Gond.*; Kumkam, *Tel.*

A tree 20—30 ft. branched low, with ovate or rhomboid acute or acuminate leaves 3—5″ (attaining 9″ exceptionally) long covered beneath when young with a greenish-yellow glandular pubescence and permanently with small red glands Fls. racemed. Capsule densely covered with red glands.

Fls *Oct.—Nov.* Fr. *Feby.—March.*

Occasional in moist valleys in all divisions. Frequent in Rai. and S. Ch.

The red glands from the capsules form the Kamela dye

Homonoia riparia, *Lour.* Taniki, *Tel.*

A large shrub with numerous erect branches from near the root and long willow-like leaves 3·5—10″ densely lepidote beneath. Fls. in long axillary spikes. Capsule ·2—·25″ tomentose.

Fls. *March—April* with the young shoots. Fr. *May—Sept.* Deciduous.

Along rocky and sandy river beds. Scattered throughout the circle but local.

Homonoia retusa, *Muell.*

A smaller shrub than the last with obovate leaves 1 - 2″ long cuneate at the base and more or less toothed. Fls. in short spikes Capsules ·1—·15″.

Fls. *Dec.—March.*

Along rocky river beds. Only noted from N. and S. Ch and N. Ward, but probably in all the Western and Southern Divisions.

Ricinus communis, *L.* The Castor-oil, with large palmately nerved leaves, is frequently cultivated.

Gelonium lanceolatum, *Willd.*

A small straight much branched quite glabrous tree with smoothish grey-brown bark and rather hard flesh coloured blaze. Twigs green. L. somewhat pellucid-punctate, oblong oblanceolate with rounded tip 2—5″ long thick shining both sides, petiole ·1—·2″ long, the nodes with an annular stipular scar. Fls. minute green in few fld. leaf-opposed clusters. Fr 3-lobed ·5—·75″ diam.

Fls. *Jany.* Fr. *Dec.*

Along dry sandy nalas in Sironcha. Probably the northern most limit of this species.

Baliospermum axilla, *Bl.*

A stout undershrub with numerous erect herbaceous shoots from the root, variously lobed, sinuate or serrate leaves from very broad sub-orbicular 10″ diam to elliptic, oblong or (upper) lanceolate, 3—5-nerved at the 2-glandular base, sec. and cross tertiaries strong. Fls. greenish fascicled axillary or in leafless racemes. Capsule ·3″, 3-lobed, pubescent.

Fls., Fr. *Dec.—March.* Sub-deciduous or dying down to the root in March.

In all divisions, under shade.

Tragia involucrata, *L.* Agya ka Bhond, *Mar.*

A climber with stinging hairs, leaves 1—4″, the lower often (var. cannabina) 3-fid., all coarsely toothed. Fruiting sepals pinnatifid.

Fls., Fr. *July—Dec.*

Frequent in hedges, etc.

LVII.—ULMACEÆ.

Holoptelea integrifolia, *Planch.* Karangi-Pipal, *H.;* Papra Wavuli, *Mar.;* Namli, *Tel.*

A large tree somewhat resembling a beech tree, with light-coloured smooth bark, thick and flaky when old. Blaze cream-coloured streaked with light brown. L 1·5—4″ ell. or somewhat ovate or obovate entire, or coarsely crenate or serrate towards the apex, often cuspidate, young pubescent. Petiole ·3—·75″. Fls. very small green in numerous fascicles or short racemes on the leafless branches. Fr. samaroid.

Fls. *March—April.* Fr. *May.* Leafless at the time of flowering.

N. W.; N. Ch., frequent; S. Ch., frequent; Dhiri-Mangli Forest (Bal.); probably also in other divisions.

Even large trees sometimes have the leaves serrate in South Chanda. The branches are lopped for cattle fodder.

Trema orientalis, *Blume.* Juliki, *Tel.;* Baihar, *Bhuma;* Ghatari, *Mar.*

A fast growing small tree with light bark marked with stipular scars, ovate-lanceolate acuminate or caudate serrulate leaves 3 - 6″ long, silky or silvery beneath, with a 3—5-nerved base.

Fls. in small axillary cymes.

Fls. and Fr. *Nov.—April.*

Near streams. Allapalli (S. Ch); Lormi Forests (Bil.).

Trema politoria, *Planch.* Nai dodhara, *Gond.*

A small tree somewhat resembling the last, but the leaves are rather shorter and stiffer and less acuminate, scabrid *both* sides; and though somewhat hairy beneath not silky nor silvery. Upper surface usually shining.

Fls. *Aug.—Sept.* Fr. *March.* Evergreen.

In waste or rocky places. All divisions but local. Often on the sides of newly-made roads. Leaves used for polishing.

LVIII.—MORACEÆ.

Streblus asper, *Lour.* Karasni, *Mar.*; Baranhi, *Tel*

A small tree with tough stringy bark, rigid very scabrid (both sides) rhombic ell. or obovate leaves 1·5—4", often somewhat toothed and acuminate, petiole very short. Fls. mostly from above the leaf scars. Male in very small heads which are ·25—·3 diameter. Fem. (on separate trees) solitary with 2 very long styles. Fr. small yellow fleshy (coriaceous pericarp enclosed in the tubular perianth) ·2" diam.

Fls. *March—May*. Fr. *May—June*.

In all divisions, chiefly near nalas.

The leaves are much browsed. The juice is slightly milky in the cold weather. The twigs are used for tooth-brushes.

All the figs (Ficus) have milky juice.

Ficus gibbosa, *Blume.* Gasti, *Gond.*

A large epiphyte frequently becoming an independent tree with large sub-rhomboid, mostly unequal sided, leaves 2·5—8", very hispid above, pale pubescent beneath with 4—5 prs. prominent sec. n. above the 3-nerved base. Recepts stalked

Fls., Fr. *Feby.—April.*

On old buildings, trees, etc., Bh. (Partabgarh fort, etc.); Rai., Bal. (Sonawani range, Baihar plateau, etc.,) frequent.

Ficus bengalensis, *L.* Bar., Bargat, *H.*; War, *Mar.*; Bareli, *Gond.*; Marri, *Tel.*; The Banyan.

A very large tree, sending down aerial roots from the branches, usually starting life as an epiphyte. Shoots pubescent. L. ovate to ell. 4—8 entire with 3—7-nerved rounded or sub cordate base, old glabrous or usually pubescent beneath. Petiole ·5—2. Stipules ·75—1". Fruits sessile scarlet in pairs, ·5—·75" diam.

Fr. *March—May* and *Dec.—Jany.* Nearly evergreen.

In all divisions, wild and often planted. A well-known tree easily propagated by large cuttings (several inches thick). Useful for elephant fodder.

Ficus tomentosa, *Roxb.* Son Pakar, *H.*

A large or small tree with tomentose or woolly stout branchlets and frequently with thin aerial roots. L. very variable in size 2—8·5", easily recognised by the more or less persistent tomentum and prominent venation beneath, by the cordate base and a longitudinal gland on the midrib beneath.

Fl., Fr. all the year. New recepts appear in *June.* Nearly evergreen. Usually among dry rocks. In all divisions. On the tops of quartzite cliffs, Bawanthari range (Bh.);

Ficus retusa, *L.* Gadasi, *Gond.*

A small or large tree usually epiphytic when young, with rotund, obovate or elliptic leaves 1·5—3" (up to 5" in one form) always with cuneate 3-nerved base and very slender sec. n. about 5—12" each side with intermediary nearly as strong. Petiole ·25—·5". Recepts ·2—·4" diam. sessile, white or purple.

Fls. *Feby.—May.* New recepts appear in *November.*

Near nalas N. Ch. and Rai., frequent (on rocky hills near Ghatula, Raipur, and on Satbhaini Hill, North Chanda, a small tree with very erect branches); Bhandara, frequent; Bil.; S. Ch., rare (Donald).

Ficus religiosa, *L.* Pipal, *H.*; Rai., *Gond*; Rage, *Tel.* The Peepul tree.

A large glabrous tree starting life as an epiphyte. This is the true 'Peepul' which may be distinguished from other figs, sometimes confounded with it by the ovate-rotund leaves with the very long caudate tip one-third to half the entire length of the leaf.

Fls., Fr. *March—June.*

Common in all divisions and often on buildings. Branches much lopped for fodder and the fruit eaten.

Ficus Arnottiana, *Miq.* (sometimes called Pipal.)

A glabrous shrub or small tree with broadly ovate leaves 4—7" long somewhat resembling those of 'Peepul' but shortly suddenly caudate or cuspidate, the cusp not exceeding ·7". Base

always *caudate* one strong and 1—2 much weaker nerves each side of the midrib. Petiole about half as long as the leaf or more. Recepts usually paired globose ·3—·5″ diam. when ripe, sub-sessile or shortly stalked, faintly verrucose.

Fls., Fr. *March—June.* Deciduous *April.* New leaves bright red. Chiefly on rocks and dry hills. Bh.; S. Ch. Probably in all divisions.

Var. courtallensis.

L. ovate, mostly 3·5—4″ only, base rounded or slightly cordate, or somewhat cuneate on the petiole, 5—7-nerved with the petiole 2·5—3″ or as long as the blade. Recepts only ·28—·3″ diam. when ripe verrucose, flushed red, pedicelled, slightly umbonate.

Fr. ripe *Dec.—Jany.* Leaves turn copper coloured in *Dec.*

On the top of quartzite cliffs in the Bawanthari range (Bhandara).

Ficus Rumphii, *Bl.* (sometimes called Pipal.)

A small or m. s. tree with ovate or broadly ovate leaves 5—6″ long gradually tapering to the acuminate tip and with straight, obtuse or retuse base hardly ever cordate. Surface closely minutely punctulate when green, showing as minute tubercles above when dry. Petiole one-third to three-fourths as long as the leaf much shorter and stiffer than in the Peepul.

Recepts nearly always paired sessile, globose to oblong-obovoid ·5″ diam.

Fls., Fr. *Jany.—March.*

This tree seems to me not to be epiphyte and is usually found near dry water-courses in Chota Nagpur. Rare in C. P. (Bil.).

Ficus Tsiela, *Roxb.* Pakhar, *H.*

A low or large spreading tree often epiphytic, "sometimes sending down aerial roots like a Banyan."—*C. G. Rogers.* Bark white. Blaze with a thin chlorophyll layer, then pink or red or banded pink and white. L. 3·5—5·5″ coriaceous ovate or narrowly ovate with rounded or cuneate or oblique base and very short bluntly cuspidate or acute apex, translucent punctate when green,

showing minute tubercles above when dry. Sec. n. 1—2 close to the base each side and about 8—10 prs. above, with weaker ones between. Petiole 1·5—3". Recepts about ·5" diam. globose or globose-pyriform from a broad base, 1—2 axillary or from leaf scars, sometimes deep purple in all stages of development, and others white.

Fls., Fr. *Dec.—Feby.*

Common, usually on alluvial soil. Bawanthari range (Bh.); Balod and Dhamtari range (Rai.); N. Ch.; S. Ch.

[Rather variable. In some forms the innovations and recepts are pubescent. The sepals of the female flower are described in F. B. I. as ovate and shorter than the achene. I find them often obovate and as long as the achene. Mr C. G. Rogers' interesting specimen grown in deep alluvial soil near the Tapti River in Nimar had aerial roots. One Chanda specimen had acuminate leaves 7" long, thus looking somewhat like F. Rumphii.]

Ficus infectoria, *Roxb.* Pakhar, *H.*; Jurvi, *Tel.*

A m. s. or large tree, always epiphytic at least when young. Leaves 3—6" much thinner than in *F. Tsiela*, sub membranous, mostly oblong or oblong-ovate, less often ovate, rather abruptly shortly acuminate, surface finely reticulate with raised nervules but *not* tuberculate when dry, base rounded or sometimes sub-cordate or narrowed, 3-rarely 5-nerved, other sec. n. 5—10 each side, looping within the margin. Petiole slender 1·5—2·5 rarely 3·5" long (in exceptionally large leaves). Recepts sometimes pubescent mostly paired ·25—·3" diam. or sometimes ·5" globose but without the broad base of Tsiela and often (var. Lambertiana) peduncled, whitish or flushed with red.

Fls., Fr. *Dec.—June.*

In all divisions rather common.

Ficus Tjakela, *Burm.* Kel, *Mar.*

A m. s. or large tree with stout dark grey branches, coriaceous leaves 3—7·5" oblong-ovate or ovate or oblong shortly abruptly acuminate with broad rounded or subtruncate or cordate base

which is only 3 (rarely 5-) nerved, margin often undulate, sec. n. 5—12 prs. very finely reticulate between. Petiole 1·5—2·5″. Recepts small, only ·2″ diam. in clusters of 2–6 *on nodose tubercles* mostly at the scars of fallen leaves, rarely only 2 in the cluster. Basal bracts 2-fid.

Fls., Fr. *Feby.—March.*

Var. **rupicola**, *Haines.*

The typical plants are quite glabrous, have oblong or oval leaves which are beautifully glossy above. Sec. n. 7—12 each side. In variety 'rupicola' the innovations are densely pubescent, bracts more or less silvery pubescent and young recepts tomentose, the leaves are oblong-ovate or ovate, not at all glossy above, scarcely glabrescent beneath, and sec. n. 5—7 each side only. The fls are similar.

On quartzite rocks, Satbhaini pahar, N. Chanda.

Ficus heterophylla, *L. f.*

A creeping pubescent shrub with membranous entire or lobed coarsely toothed or repand leaves 2—5″ long, scabrid both sides, and solitary axillary peduncled recepts.

"In the bed of the Pranhita river, S. Ch."—*Donald.*

Ficus hispida, *L. f.* Katamba, *H.*; Bul Dumar, *Chh.*; Katumbar, Dherumber, *Mar.*; Thedu., *Gond.*; Bameri, *Tel.*

A tree 15—25 ft. high with thick hollow branchlets, easily distinguished from all the preceding figs by some or all of its leaves being opposite, ovate-oblong, 4–12″ long, scabrid or hispid. Recepts 1″ diam. numerous fascicled on both the trunk and the branches or on special leafless drooping branchlets but sometimes also axillary.

Fls., Fr. *Jany.– Feby.*

Moist places and often in the village hedges. Bil.; Bal.; N. W.; Rai., S. Ch.; doubtless in all divisions. Bark yields a fibre, fruit eaten.

Ficus Cunia, *Ham.* Dumba, *Gond.;* Bui dumar, *Chh.*

A small or m. s. tree easily recognised by its large shortly petioled leaves 6—15″ long with a semi-sagittate base. Recepts ·5—·75″ diam. in prs. or clusters on long (often several feet) usually leafless drooping branches, especially near the root.

Fls., Fr. chiefly *May—June,* also *Aug.—Sept.* Evergreen. Moist ravines. Paraswara (Bal.) ; Lormi Forests (Bil.) ; Rai.

Ficus palmata, *Forsk.*

A small erect tree with general habit of the true 'Fig-tree' but with hoary or pubescent branches and the leaves tomentose beneath usually entire. Cultivated in Nagpur and other places, native of Upper India.

Ficus glomerata, *Roxb.* Gular, Dumba, *H.;* Umbri, *Mar.;* Toya, Atti, *Gond.;* Moidi, *Tel.*

A m. s. tree with thick crown, ovate, ovate-lanceolate or ell. dark green leaves 4—7·5″ narrowed to an obtuse or sub-acute tip, pale and pubescent on the nerves beneath, base rounded rarely acute 3-nerved. Petiole ·75—1·75″ pubescent. Recepts 1—1·5″ diam. reddish, globose or pyriform pubescent on cauline and rameal special branches usually short (but sometimes 2 ft. long) ; occasionally axillary recepts are found as well.

Fls., Fr. *May—June.* Often deciduous *Oct.—Nov.* Renewing its leaves *Dec.—Jany.*

Common in all divisions and preserved in village lands for its fruit, which is largely eaten.

Artocarpus Lakoocha, *Roxb.*

A m. s. tree with large ell. or ovate obtuse or shortly acuminate leaves 6—10″ long, pubescent or tomentose beneath, with 8—12 sec. n. each side. Petiole ·5—1″. Male inflorescence ellipsoid or globose 1″ diam. deciduous. Female inflorescence irregularly sub-globose 2—4″ diam. fleshy in fruit.

Fls. (and new leaves) *April.* Fr. *May.*

Along shady flowing streams among the hills of the Lormi Forests (Bil.).

The fruit is eaten. The tree is frequently planted.

Artocarpus integrifolia, *L.* Kathal, *H.*

The Jack-fruit. It is often planted but does not grow well in the circle, the climate being too dry.

LIX.—URTICACEÆ.

Boehmeria platyphylla, *Don.* Var. macrostachya, *Wedd.* (sp.).

A shrub 4—6 ft. with large ovate leaves 5—10" long very coarsely toothed and with strong basal nerves. Diœcious. Male fls. clustered on long sub-erect spikes reaching 16" long. Female on short spreading spikes 2—3" long.

Fls. *Sept.—Jany.*

Ravines of the Lormi Forests, Bil., elev. 1,500—2,000 ft.

LX.—SALICACEÆ.

Salix tetrasperma, *Roxb.*, Wandra, *Mar.*

A tree with fluted bark and thin pink blaze or, in some forms a shrub, with silkily-pubescent shoots, lanceolate acuminate sometimes cuneate serrate leaves 1·5—3" long, pale glaucous beneath with 10—20 very fine sec. n. each side (nervules not at all raised beneath from which it may easily be distinguished from Homonoia). Diœcious. Both male and female fls. in slender spikes on the new shoots.

Fls. *Feby.* with the new leaves. Fr. *March.* Deciduous.

Along Garwi nala, Bhandara ; N. Ch. ; streams in the Lormi Forests (Bil.).

TEAK IN BURMA.

By "OP."

1. Teak is a strong light-demander, although it can stand some shade in early youth.

2. The Selection system is unsuited to a tree with the sylvicultural characteristics of teak.

3. Teak should be grown in even-aged crops.

4. With the forests in their present condition, natural regeneration producing an even-aged crop cannot be managed.

5. Therefore recourse must be had to artificial regeneration

6. Areas of pure teak forest smaller than 100 acres are administratively and economically unpractical.

7. Areas of artificially pure forest larger than 500 acres are liable to serious damage from insects and fungi.

8. Therefore artificial regeneration should extend over tracts between 100 and 500 acres in area.

9. After 40 years of age, pure teak becomes so open as to expose the soil ; but in Burma bamboos prevent damage ; bamboo is of doubtful economic value in remote localities, and it would be better to underplant at 40 years or so with Pyinkado or with some shade-bearer (Madama, Thitni, Kanaso, Thadi, Gyo) which is mature at 80 years of age ; Pyinkado would do for house-posts at this age. Underplanting would reduce the risk of danger from insects and fungi. The underwood would be removed first and the area then naturally regenerated when the teak was 100—120 years old.

10. Sowing in lines is preferable to broadcast in order that the seedlings may be found when weeding has to be done

11. Pure groups are preferable to mixed groups because the rate of growth of different species is never the same, with the result that trees mixed individually never clean themselves of side branches. Therefore pure original crops followed by underplanting are better than crops mixed individually from the beginning.

12. The flowering of the various species of bamboos affords an excellent opportunity for the formation of pure crops over definite areas: and as some species of bamboo flowers every year

somewhere in every division, these flowered areas should be stocked artificially every year, no such plantation being less than 100 or more than 500 acres. The system of "Taungya" plantations should not be abandoned, but it will be possible to apply this method only when the flowered area is suitable for an agricultural crop, and this will be the case but rarely. The factors deciding the position of the area taken in hand for artificial regeneration must be, firstly, the suitability of the place for growing teak and, secondly, the locality where the bamboo has flowered; these areas, whether suited to the "Taungya" method or not, should be artificially restocked. *All* growth on a flowered area should be felled and burnt previous to its restocking. Range officers should submit annually a map showing the position of forests where the bamboo has flowered. With a system of this sort in force, the flowering of the Kyathaung, when it comes, would find the staff at any rate aware of the opportunity afforded, and the difficulty would be one of labour supply only, not of instructing the staff as well.

13. Systems of free position, also called systems of partial clearance, two-storied high forest, or merely systems of underplanting are pre-eminently adapted to the sylvicultural characteristics of teak; all pure teak plantations in Burma of 40 years age or more should be severely thinned and underplanted without delay. Where there is a sale for bamboos, these should be employed as well as trees for the underwood.

14. To cope with the increased weeding, thinning, and tending operations, a permanent trained skeleton staff of labourers should be maintained. These men can be employed all the year round at nothing except tending operations, and their numbers should be increased by the addition of local labour. But the entertainment of a permanent staff of labourers specialising in tending operations is a corollary to the acceptance of the foregoing postulates.

REMARKABLE GROWTH OF *EUCALYPTUS RUDIS.*

BY R. N. PARKER, I.F.S.

The accompanying photograph (Plate 13, Fig. 1) shows a row of *Eucalyptus rudis* plants growing in the Government Agri-Horticultural Gardens, Lahore. These plants are approximately three years old and average 30 feet in height, one specimen having reached a girth of 1 foot 8 inches at 4 feet 6 inches from the ground. The seed from which these plants were grown was sown in April 1911, the plants being planted out about August 1911. The photograph was taken at the end of February 1914, so that the plants were under three years old. Several of them have flowered and were in fruit when the photograph was taken. They have received constant irrigation since they were planted. The second photograph (Fig. 2) shows a specimen of the same age 10 feet high. This plant is growing in a patch of ground heavily impregnated with salt, the salt forming a white crust on the surface of the soil and sufficiently concentrated to prevent the growth of all ordinary plants and weeds. Fringing the edge of the salt patch is *Suaeda fruticosa*, a plant specially adapted for growing on saline soils, but the amount of salt in the patch has reached the limit which this plant can tolerate as only a few scattered specimens are to be seen in the centre of the patch. When planted out the Eucalyptus was set in a hole 18 in. diam. and 18 in. deep, filled with good soil, but this soil does not long remain free from salt and after a few waterings the salt spreads right up to the base of the Eucalyptus stem.

As regards the growth and uses of *Eucalyptus rudis* in Australia little information is available and its very rapid growth, even compared with other members of the genus, appears to have been discovered in California. A. J. McClatchie in "Eucalypts cultivated in the United States," 1902, mentions *E. rudis, E. viminalis* and *E. Globulus* as being the fastest growing out of the 68 species he deals with. The growth of *E. rudis* in Lahore, where neither *E. Globulus* nor *E. viminalis* can be grown, is very much faster than any of the other species tried. As regards the capacity of *E. rudis* to resist salts in the soil, R. H. Loughridge in

Fig. 1.

Fig. 2.
Remarkable growth of *Eucalyptus rudis*
at the Govt. Agri-Horticultural Gardens, Lahore.

"Tolerance of Eucalyptus for Alkali," 1911, says: "The fact that not one of its seedlings was killed in the last row while all other species lost numbers of their seedlings, would seem to place the *rudis* as first among alkali-resistant eucalypts."

For satisfactory growth *E. rudis* apparently requires a very dry climate. In 1911 I saw some plants which were supposed to be *E. rudis* in Dehra Dun but they have apparently all died. A plant put out a year ago shows little prospect of doing well, though still alive it is about the same size as when planted. An abundance of water is not essential as in the Kot Lakhpat plantation near Lahore. *E. rudis* is growing remarkably well with only moderate irrigation and with long intervals between successive waterings.

CULTIVATION OF NATURAL TEAK SEEDLINGS IN THE HALIYAL TEAK POLE FORESTS WORKED ON THE COPPICE-WITH-STANDARDS SYSTEM.

(Being a paper presented by Mr. Copleston at the last Poona Forest Conference.)

The forests in question border the Dharwar district and the rainfall should be about 50".

In dry years, however, it is often much less, in 1899 it was 28" and in 1911 even less.

In January dry winds render the forests quite leafless and in April the soil is thoroughly parched up. In consequence of the annual drought the innumerable seedlings which may be found on the ground in the rainy season all die. Most of them are rendered weak and etiolated by the grass which chokes them from September to December.

To save these seedlings some experimental cultivation was tried on a small scale with success in 1911.

Some of the forests are almost pure Dindal and most of the area is barely half-stocked so far as teak goes.

To get the full value out of these forests regeneration of teak from seedlings is essential and with a view to bringing this about the natural seedlings are sought out and cultivated.

The work is carried out by the guards and by coupe *malis*.

The following is the procedure :—

The Round Forest Officer is responsible for carrying out the following works :—

The coupes are closed by April 15th, though it would be preferable to close them by April 1st.

As soon as closed, the coupes, when situated near a village, are fenced with thorns and brushwood.

After fencing the coupes by May 15th natural seedlings are marked by teak stakes placed to the west of the seedling about one foot distant from it but leaning towards the plant. The stakes must be about 3' long and as thick as a man's wrist.

These stakes mark the position of the seedling and support a shade for the hot weather.

For a space of $1\frac{1}{2}$ ft. round each seedling the ground is weeded and a little loose earth spread, but care must be taken not to place earth against the stem of the seedling.

The weeding is continued throughout the rains, the weeds are left lying within the 3 ft. circle and at the end of the rains in October loose earth is again spread round the plant burying the dead weeds.

During December and January the seedlings are shaded by placing a bundle (*pendi*) of grass over the plant fixing it on the stake in such manner as to shade the plant from the midday and afternoon sun.

Another sprinkling of soil is required in February. The grass-shades are removed again in the latter part of April when the above process is repeated in the next lot of coupes. The value of a soil-mulch is generally not realised by farmers from temperate climates and it is only recently discovered by colonists that vast stretches of country which were regarded as useless deserts are capable of producing fine crops of wheat though no rain may fall from the day the seed is put in till the time of harvesting.

Soil-mulch is any material spread upon the soil to shade the surface from the sun, to break the connection between the water-bearing subsoil and the exposed surface.

Timely tillage is necessary to prevent the formation of a soil-crust which would permit moisture to evaporate.

Should there be any shower in the hot weather the broken soil and mulch round the plant not only soak up every drop that falls round the plant but also takes up much that flows down the hillside. The soil surface of most hills in this country is a hard close crust from which all the rain-water of the hot weather showers runs off.

Again the soil-mulch smothers the weeds which are in themselves moisture robbers, and the broken soil improves by exposure to the sun and air. Thus we have the dry soil blanket not only checking evaporation and smothering weeds but also holding up the rain-water when it is most required and at the same time gaining in its own power of fertility by exposure to the sun and air.

In 1909 the system was tried in the Para nursery beds at Gersappa with remarkable success. Beds which were watered at a cost of over Rs. 5,000 during the previous dry season did far better *without any watering* during the next season when they were treated with a liberal soil-mulch and cultivated at a total cost of Rs. 85.

During the past hot weather hardly a teak seedling treated by the above described method in the Haliyal Teak Pole forests died and over 30,000 were brought through the hot weather. Since April last 76,000 seedlings have been staked out in the next lot of coupes. Left to themselves not 1 per cent. of these would survive. Also nearly a lakh of seedlings were raised in nurseries without watering at all.

EXTRACTS.

A SUBMERGED OAK FOREST IN RUSSIA.

With the title of Oak Deposits (1914), Ltd., a company has been formed, with a nominal capital of £150,000 in shares of £1 each, and the prospectus is now being issued. The object of the company is to work a submerged forest of oak recently discovered in Central Russia in the bed of the river Moksha, a tributary of the Oka, which runs into the Volga at Nijni Novgorod. The discovery was made by Colonel Peter Ivanoff, of the Russian Naval Diving Corps, and owner of property along the river bank. It is stated that the bed of the river is paved with immense logs of oak for a distance of nearly 500 miles. The existence of logs has long been known to the neighbouring peasants, and for generations they have fished up logs whenever they wanted to build a cottage, a cow-house, or to make new furniture. But the first to turn the forest to practical account on an extensive scale appears to be

Colonel Ivanoff, who obtained a concession from the Russian Government and secured the rights of the riparian owners for a distance of 450 miles along the Moksha. The result was the formation of an English syndicate and the issue of the prospectus just mentioned. We have examined samples of the wood, which in colour is dark grey, bordering on black, as if it had been impregnated with creosote; but the grain of the wood is distinctly visible, and there is no sign of either petrification or rot. The wood is apparently quite fit for cabinet work, panelling, etc., and it is mainly to these purposes that the directors of the company hope it will be devoted. It is supposed that the forest has lain under the water for at least 1,000 years, and that the cause of the submersion was volcanic. Anyhow, the discovery is a very interesting one, and if the expectations of the directors are fulfilled the property should be a veritable Eldorado. We understand that upwards of 100 of these great logs will very soon be shipped from Libau to London and offered for sale to the trade. It is estimated that the logs recovered and exported should fetch an average price of 10*s.* per cubic foot, and as the royalties are only 6½*d.*, the freight, etc., 1*s* 6*d.* per cubic foot, and labour in Russia is cheap, it certainly looks, should all these anticipations be justified, as if once more there would be an opportunity of acquiring "wealth beyond the wildest dreams of avarice."—[*Timber Trades Journal*]

JAVA TEAK.

Teak forests in Java cover 1,480,000 acres, and, as the area reafforested is two and a half times as large as the area felled in a given time, this magnificent stock of timber is continually increasing. A pest of the Java teak plantations is alang grass (*Imperata arundinacea*). In order to prevent the incursions of this plant, as hoeing is too expensive, the foresters sow a leguminous plant, *Leucena glauca*, between the rows of teak seedlings. This chokes the alang, keeps the soil clean, and enriches the soil in humus and nitrogen, and ultimately disappears with the increase of the forest cover.—(*Scientific American.*)

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PERIDERMIUM CEDRI AS A DESTRUCTIVE FUNGUS.

BY R. S. TROUP, I.F.S.

In an article under the above title contributed to the *Indian Forester* of May 1912 (page 222), I endeavoured to show that the Deodar "witches' broom" fungus, *Peridermium Cedri*, Barclay, which until then had been considered of no importance as a pest, and which even now appears to be little known and seldom recognised, was not so harmless as was generally believed: this contention was supported by one or two instances in Jaunsar, where the damage done by the fungus was by no means trifling. Observations made during a recent tour in the Punjab Himalayas have now convinced me not only that the disease is more widely spread than has hitherto been supposed to be the case, but that it is a far more serious one than I had hitherto imagined.

Of the localities visited, the most seriously affected area is situated in the Beas Valley at Monali in the Kulu Division. Here there are pure deodar plantations aggregating 189 acres and dating from 1875 onwards. In these plantations the trees have been dying off in numbers for many years past. Various conjectures as to the

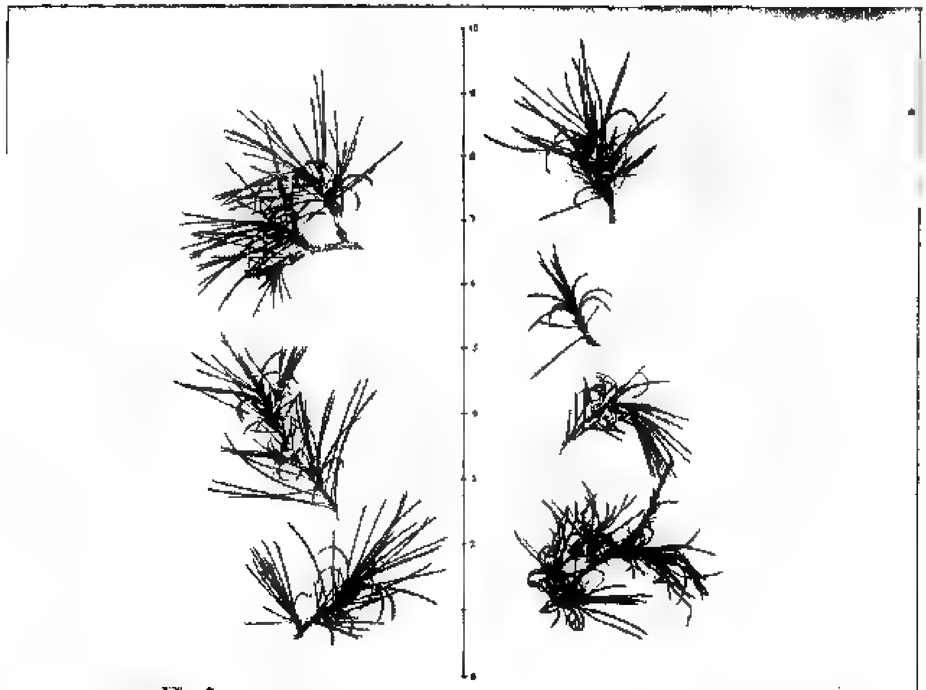
precise cause of this mortality were made from time to time: it was attributed generally to a fungoid attack, though the presence of a definite fungus was not detected, while at one time it was put down to bad drainage. An account of the damage done is described by Babu Guran Datta Mal, Forest Ranger, in the *Indian Forester* of October 1906 (page 518), in an article entitled "Impending Danger to Deodar Forests in the Kulu Forest Division, Punjab." Efforts were made to trace the cause of this mysterious disease, but without success.

I had occasion to visit these plantations in May this year, and an examination of felled trees revealed the cause of the mortality to be none other than the fungus *Peridermium Cedri*. The appearance of affected stems is characteristic. The foliage first becomes thin a short distance below the leader, and the twigs and then the larger branches commence to die. The leader remains alive for some time, but eventually dies. As the attack spreads the whole tree dies. If an affected tree is felled and examined about the month of May, the new needles on the diseased twigs will be found to be curled back and covered with yellow flecks, the fructifications of the fungus. The explanation of the dying of the twigs *below* the leader before the leader itself dies is probably as follows: The needles attacked are the young needles of the year, both on the leader and on the side branches; as, however, it takes one or two years for the twigs to die, the affected leading shoot does not show signs of dying till after a new leading shoot has taken its place in the following year, by which time the previous year's shoot is situated some little distance below the new leader.

The Monali plantations are situated in a rather moist valley, on flat ground, at an elevation of 6,000 feet, a locality no doubt favourable for the spread of the fungus. Apart from the plantations, many of the natural trees in the neighbourhood are badly affected, and the disease is also prevalent in the natural forests on the hillsides above the valley.

The severity o the attack in these plantations alone would indicate that *Peridermium Cedri* is responsible for more damage to deodar than any other fungus yet recorded. Already some

Peridermium Cedri, Barcl.



1. *Needles of deodar, the curved ones affected by the fungus.*

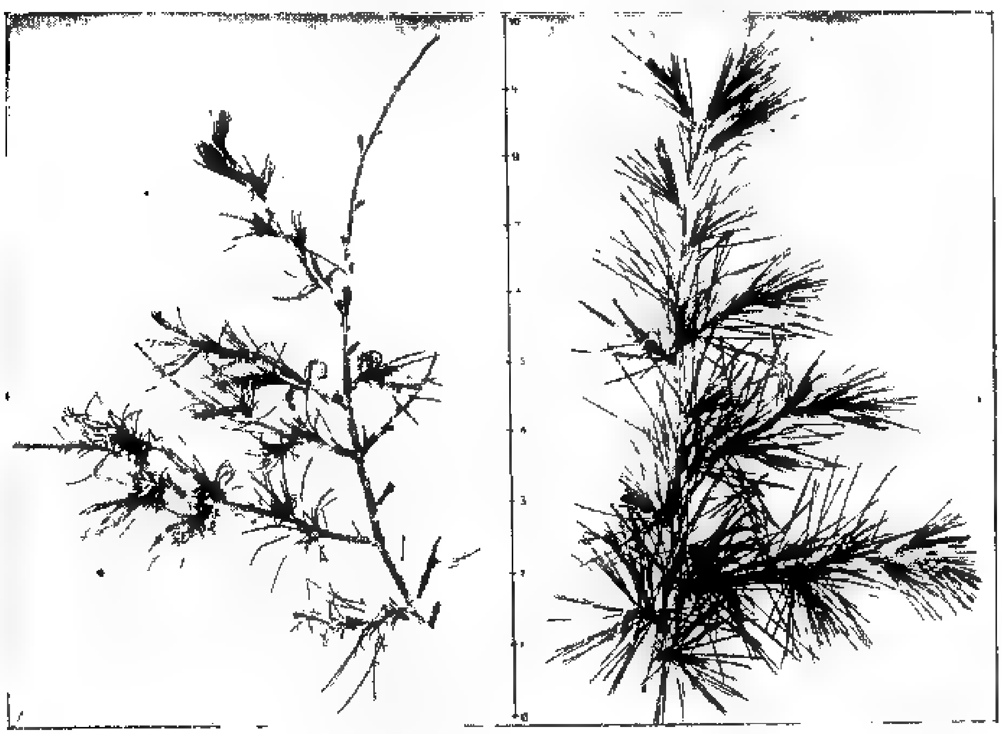


Photo-Mechl. Dept., Thomason College, Roorkee.   Photo. by R. S. Troup.

2. *Deodar twigs, affected on left, unaffected on right.*

[Note.—Scales show inches]

hundreds of diseased stems have been cut out; many more are dying, while of the survivors it is estimated that at least 80 per cent. are visibly affected. The Annual Forest Administration Reports of the Punjab Conservator for 1908-09 and 1909-10 contain references to a mysterious fungus on deodar, attempts to identify which met with no success. This fungus was reported from Kulu, Simla and the Sutlej Valley; the Kulu fungus we now know to be *Peridermium Cedri*, and possibly the same applies to that of the other localities.

Once this disease has gained hold of a crop it is practically impossible to deal with it. Cutting out affected stems may check it to some extent, but its facilities for spreading are great, and unless its presence is detected before it has gained much ground, there is little hope of exterminating it. The cutting out and burning of affected branches and witches' brooms when the disease first appears ought to be feasible: there is little difficulty in any Forest Guard recognising the disease when it has once been pointed out to him. The cutting can best be done in May, when the affected needles are conspicuous. Preventive measures would consist of avoiding damp valleys for deodar plantations and mixing deodar with blue pine or other suitable species.

This fungus requires further study. The spores ripen in May and June, and if an affected branch be shaken at that time the air becomes charged with myriads of yellow spores which scatter far and wide in the breeze. The spores apparently lodge on the young needles, and the mycelium must be present in the needles or in the shoots containing them during the winter, spreading into the next year's young needles in the following spring, since it is on these needles that the fructifications appear next May. It is the earlier-formed needles that are attacked, that is, those on the lower part of the rosette; the later (central) needles remain straight and normal. The curved form of the affected needles persists after the spores escape, and is the outward sign of an affected twig when the fructifications are not present. Plate 14 shows examples of deodar branchlets attacked by the fungus: the photographs were taken in May.

As regards the distribution of the fungus, I have noticed it in all deodar tracts hitherto visited, namely, Jaunsar (fairly prevalent) Kulu (very prevalent, both in valleys and on hillsides), Bashahr, Nogli Range (fairly prevalent), Simla Hills (a few cases along the Simla-Narkanda road, the only portion of these hills visited so far). It would be interesting to know if the fungus occurs in the drier deodar tracts of the Upper Sutlej Valley, and if it is found in Chamba, Hazara and Kashmir.

LIST OF THE TREES, SHRUBS AND ECONOMIC HERBS OF THE SOUTHERN CIRCLE OF THE CENTRAL PROVINCES.

(PART VIII) -*Concluded.*

BY H. H. HAINES, I.F.S.

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CLASS—MONOCOTYLEDONEÆ.

LXI.—ZINGIBERACEÆ.

Curcuma longa, *L.* Tawkir, *Mar.*

The fls. of this plant have not yet been seen and the identification is uncertain. Tubers were collected by Mr. Beechey and Mr. Cole, these sent up leafy shoots the first year but they did not flower before I left India. The rootstock is long, cylindrical ·75—1′ diameter or roundish conical and branched, colour light grey-yellow. They are used in the preparation of native sweetmeats, and 'Tawkir' is included in the leases for " Minor Forest Produce." Several species of Curcuma grow in the forests but good specimens are still required. They flower in the rains.

Zingiber capitatum, *Roxb.* Ran ala, *Gond.* is common in all divisions. Zingiber Casumunar, *Roxb.* common in Raipur. Fr. *November.* They do not appear to be used.

LXII.—MUSACEÆ.

Musa sapientum, *L.* (Var. sylvestris, *Prain.*). Jangli Kela, *H.*; The Wild Plantain.

A tree-like herb 8—12 ft., bracts of the inflorescence deep red or purple, arranged on an elongate drooping spike, the females at the base of the spike, the terminal bracts forming a dense club. Frt. with a coriaceous rind and numerous black seeds. Valleys in the Lormi Forests, elevation, 1,000—2,000 feet.

LXIII.—AMARYLLIDACEÆ.

Curculigo orchioides, *Gaertn.* Kali Musali, *H.;* Musar Kand, *Gond.*

A small plant with bright yellow star-like fls. just thrust above the ground by the elongating hypanthium ('perianth-tube') L., often very small at the time of flowering, linear-lanceolate, plicate, up to 12″ long. Capsule with a short beak 4-seeded.

Fls. *May—August.* Dies down in the cold season.

Common in all divisions.

Tubers of Musar Kand obtained by Messrs. Beechey and Cole were in long cylindrical root-like pieces about ·3—5″ diameter. They are often included in leases of "Minor Forest Produce" and appear to be used as a tonic.

Crinum latifolium, *L.* is a handsome plant with umbels of large white or pinkish fls., 8—9″ long. Found on the plateaux.

Crinum ensifolium, *Roxb.*, also with umbels of white fls., but with much narrower petals, is common along the river banks.

Pancratium longiflorum, *Roxb.*, Panjan Kanda, *Gond.*

Bulb bottle-shaped or globose up to 2·5″ diameter with a long neck and with membranous brown skin. Fls. white 1—2 on the scape, the slender tube 4·5—6″ long and lobes lanceolate 2—2·5″. The stamens are connected by a membrane into a cup about 1—1·5″ long, divided into 6 oblong 2-horned segments.

Fls. *June.*

Bandhara, Balaghat, etc.

Two kinds of bulbs have been received by me under the name of Panjan Kanda, the second failed to flower and was apparently

a species of Eulophia. Panjan Kanda is included in the leases of "Minor Products" but why it is collected is not clear. Pancratium is used as a size by Koshtis who make hand-woven cloth.

LXIV.—DIOSCOREACEÆ.

Several of the species of Dioscorea have fleshy bulbils in the axils of the leaves which the natives call 'phal,' the real fruits, however, are 3-winged coriaceous capsules. The vernacular names are very loosely applied as even the forest races sometimes confuse the species, unless they actually dig up the tubers. Fuller descriptions are given in the Forest Flora of Chota Nagpur.

Dioscorea daemona, *Roxb.* Baichandi, *Mar.* (This name is a reliable one); Tikhur, *Gond.;* Dukarkand, *Mar.* (*f. Donald.*)

A climber with 3-foliolate leaves, lflts. about 7·5" long, 5—6 costate, more or less obovate. The stems have a few small prickles below. Capsules large, oblong 1·5—1·75".

Fls. *July—Sept.* Fr. *Sept.—Jany.*

In all divisions, common.

According to Roxburgh the rhizome is dreadfully nauseous even after boiling. Mr. Donald says it is not eaten in South Chanda. It is sub-globose, or irregular up to 12" diameter, marked with eyes and covered with root fibres and slightly poisonous. After frequent washings it is said to be sometimes eaten, and is used in the C. P. for making several kinds of sweetmeats It is included in leases of "Minor Forest Products."

Dioscorea pentaphylla, *L.* Musalkanda, *Vern.* (but see also Curculigo); Padimuskir, *Gond.;* Pandigada, *Tel.*

A much more slender plant than the last with 3—5-foliolate leaves and the leaflets only about 4 long, rarely attaining 6". The stem prickly below. Capsules oblong ·75—1"

Fls. *August.* Fr. *Nov.—Feby*

In all divisions. Leaves in one form pubescent or hairy and the bulbils sub-globose, faintly tessalated, in another glabrous with

elongate or pyriform bulbils. Sometimes said to be eaten or used as a tonic.

Dioscorea bulbifera, *L.* Mataru, *Mar.*

Stems smooth from a large brown sub-globose rhizome covered with eyes and roots. Leaves simple sub-orbicular to broadly ovate and cordate abruptly caudate 7—11-costate with very distinct cross nervules. Sepals, linear. Capsule oblong.

Fls. *July—Sept.* Fr. c. s.

All divisions very common. Rhizomes acrid, but sometimes eaten after repeated washings of the starch.

Dioscorea alata, *L. is the commonly cultivated yam.*

Dioscorea aculeata, *L.* Pindigida, *Tel.*

Stems very stout, somewhat thorny below and characterised by the hard, thick bases of the petioles which are also sometimes thorny. Tubers elongate 1—3 feet and 2—4' girth, usually rising directly from the base of stem. L. mostly alt. sub-orbicular as broadly ovate with a large basal sinus and usually cuspidate. Sepals, oblong-ovate. Capsule, 1·5' diameter, broader than long.

Fls. *Nov.—Dec.* Fr. *Jany.*

Dioscorea belophylla, *Voight.* Pitaru, *Vern.* (Bil.); Kuru Kanda, *Vern.* Nagpuri; Nand Kand or Kandar, *Gond.* (Bal.); Jangli Matol, *Mar.* (S. Ch.); Gundia, *Tel.*

Stems quite smooth, enlarged at the base into a small rhizome, bearing tubers at the ends of long fleshy fibres; these tubers are sometimes 2 feet long and are very deep in the ground.

L. opp. and alt. sap-green, dull above, glaucous beneath, usually ovate and deeply cordate with well-marked cross nervules (even when fresh) between the costate beneath, the latter decurrent into the petiole. Sepals nearly free, oblong obtuse dotted and with scarious margins. Capsule 1" broad.

Fls. *Sept.—Nov.* Fr. *Dec.—Jany.*

Bilaspur (common); Bal.; N. Ch.; S. Ch.; N. W. (?)

The most highly prized of all the forest yams and very deep pits are sometimes made in the forests to get at the tubers.

Dioscorea oppositifolia, *L.* Syn. D. nummularia, *Lamk.*, D. glabra, *Roxb.*; *Girs Kanda, Sut Kanda, Gond.*; *Gilandru*, Choratogu, *Mar.*

Stems smooth or with numerous small prickles below, enlarged at the base into a small rhizome and bearing tubers as in the last 5—12' by 1—2" diameter. Leaves opposite, rarely also alternate, glabrous, pale glaucous beneath, *usually ovate oblong, and cordate* below, base of oblong upper leaves often rounded, straight or cuneate. Male spikes whorled ·5—1·75" long and often copiously panicled. Base of perianth broad and pulvinate.

Sep. oblong. Petals obovate spathulate. Capsule, 1—1·25" broad, often *stipitate.*

Fls *Sept.—Oct.* Fr. *Nov.—Dec.*

In all divisions.

Var. (oppositifolia F. B. I., p. 292.) Less coriaceous. More or less pubescent. Leaves said to be never cordate. I am unable to separate, as two *species glabra and oppositifolia by the* characters usually given, but there are two forms, one with small flowers in lax spikes, the other with larger flowers in dense close spikes.

The tubers are eaten.

Dioscorea anguina, *Roxb.*, Bansera, *Gond.*; Pindigada, *Tel.*

Stem unarmed, soon thickening into a cylindrical tuber 1—more feet long which is often palmately branched. L opp. very broadly cordate-ovate below, upper ovate.

Easily distinguished from the other species by the thin leaves, somewhat shiny below, being very pubescent when young and pubescent on the nerves beneath even when old. Panicles tomentose or pubescent. Capsules tomentose or glabrescent.

Fls. *Sept.—Jany.* Frt. *Dec.—Jany.*

In all divisions, common.

LXV.—LILIACEÆ.

Smilax macrophylla, *Roxb.*

A stout prickly climber with stipular tendrils on the young shoots and large, 6—12" long and broad, elliptic or orbicular

usually 7-costate, shining leaves. Fls. small white in umbels, umbels 1—3, rarely 5, in axillary cymes. Berry globose red when ripe

Fls. *April—June* Fr. *Nov.—Jany.*

Not uncommon in the damper valleys.

Smilax prolifera, *Roxb.*

A stout prickly climber with stipular tendrils on the young shoots and ell., rarely ell.-ovate, leaves with the sheath winged and wing more or less auricled one or both ends. Umbels in axillary and terminal panicles 3—6" long with usually a zig-zag rachis.

Fls. *Feby.—April.* Fr. *Nov.*

Ravines in the Lormi Forests (Bil.).

Asparagus racemoses, *Willd.* Sahaora, *Maria.;* Sahan sarmohi, *Mar.;* Satawari, *Gond.;* Narbod, *Vern.* (f. Graham).

A slender sarmentose shrub or climbing by means of the reflexed spines on the stems, with annual woody shoots and acicular somewhat curved, 3-quetrous cladodes, usually in threes on the short branchlets.

Fls. small white, about ·13" diameter on filiform articulate pedicels on very short racemes. Berries, 2" diameter, scarlet.

Fls. *Sept.—Nov.* Fr. *Oct.—Dec.*

Frequent in the forests, in all divisions.

Chlorophytum arundinaceum, *Baker.* Safed Musali, *H.;* Ganjagata, *Gond.*

A pretty herb with fleshy tubers, a tuft of lanceolate-linear leaves, 6—9" long, and a simple or somewhat panicled raceme, 8—18" high of pretty white fls., with sub-erect and spreading perianth leaves, ·5" long.

Fls. *April—June.*

Frequent, especially on the plateau land in Balaghat, and Bilaspur. Safed Musali appears in the market in white dry pieces, ·5—2·5" long and ·25" thick. They swell in water to a cylindrical fusiform shape, and are said to be used (like Kala Musali) as a tonic.

Gloriosa superba, *L.* Chora tige, *Tel.;* Karkari, *Vern.* (Graham).

A well-known and a very beautiful plant, 3—10 feet high with a large torulose tuberous rootstock, lanceolate leaves, 6" long, with the tip more or less converted into a tendril, and large, red and yellow fls. with crisped petals.

Fls. *July—Oct.* Dies down in the cold season.

In all divisions, in hedges, etc.

The roots and seeds are poisonous. Graham says that the root is used in Nagpur for dressing glands.

LXVI.—PALMÆ.

Borassus flabelliformis, *Willd.* Tal, Tali, *H.;* Potu Tadi Chetu (male); Penti Tadi (female), *Tel.;* Palmyra Palm.

A beautiful and well-known tree attaining 60 feet with a crown of large fan-shaped leaves.

Frequently cultivated and often self-sown.

The stalks of the unripe inflorescences, after cutting the latter, yield toddy (Tari, tadi). The unripe seed, pulp of the fruit, and the seedlings are eaten.

Phoenix sylvestris, *Roxb.* Shindi, Khajur, *H.;* Wild Date Palm.

A well-known palm with greyish-green pinnate leaves, 7—12 ft. long. Fruit 1—1·5", orange.

Frequently cultivated and often self-sown. Tapped for toddy. Leaves used for matting, etc.

Phoenix acaulis, *Buch. Ham.* Jangli Khajur, Sindhi, *H.;* Eita, *Tel.*

Stems hardly any, or thick and ovoid, covered with persistent leaf bases; lflts. fascicled, not in one plane; lowest reduced to sharp spines. Spadix 6—10", elongating to 1—3 ft. in fruit. Berry red or yellow finally black.

Fls. *April—May.* Fr. *May—June.*

In all divisions. Especially on open grassy hills, subject to frost on clay schists with quartz, and on laterite. Also very common on clays or clay-producing rocks in Sironcha.

Calamus Guruba, *Ham. Var.* Bent, *H.*; Tika, *Tel.*

A short sub-erect (in its depauperated condition ?) or extensively climbing slender cane, the stem-sheaths armed with numerous flat spines, ·25" long, the spines on the petioles often 1" straight and spreading with shorter recurved ones. Sheaths sometimes with long flagellæ armed with hooked spines covered, a rusty tomentum, mouth of sheath with a scarious ligule 1·5—2" long, which is leaf opposed and often split. L. 3—4 ft. with 25—30 pairs of leaflets. Lflts. linear acuminate about 8—10" long.

Primary spathes at first tubular covering the partial inflorescences and ultimately split open and laminar, linear oblong, with entire not lacerate mouth. Fls. and spikelets inserted at or above the mouth of their respective spathels. Frt. ·25" diameter, yellow, beaked, scales with a brown border and scarious margin.

Fls *Dec.—Jany.* Fr. *January* of the following year.

Marshy valleys, Sironcha, S Chanda, the canes are much cut out.

[*Note.*—The Central Provinces plant differs from the type by its very slender habit, short partial inflorescences, pyramidal in shape and not exceeding 4", slender, short, straight, not zig-zag, spikelets]

LXVII.—TYPHACEÆ.

Typha angustata, *Chaub.* Pangavat, *Vern.* (f. Graham.)

A tall bulrush, bearing a brown cylindrical dense spike of minute flowers.

Fls. *April.*

Marshy places.

Used for stuffing elephants' gaddies, etc.

LXVIII.—CYPERACEÆ.

Heleocharis plantaginea, *Br.*

An erect grass-like but stiff herb, consisting of flowering and barren stems but no leaves, septate when dry. Spikelets solitary terminating the stem, green to brown, of very many glumes. Nut polished smooth, crowned by the tumid articulate style base.

Fls. Fr. *Sept.—Dec.* Perennial.
Wet places, gregarious.
Chanda, Raipur.
Said to be used for stuffing.

Scirpus grossus, *L. f.* Var. *Kysoor, Roxb.* (sp.) Kesar-Kesara, *Chh.*

A very large sedge with 3-winged stems, 4—6 feet high and very long spongy leaves up to 1" broad. L. 3—4 feet long soft, without cutting edges, somewhat translucent with numerous minute transverse lines (cell-walls). Leaf-like bracts at the top of the stem 3, up to 18" long. Panicle decompound of corymbose cymes, 3—4" long, branches sub-erect, angled, scabrid, the final ramifications racemose. Nut 3-gonous smooth, brown.

Fls. Fr. *Sept.—Dec.* Perennial.

Raipur, along margins of tanks. The stoloniferous rootstocks bear black tubers which are said to be very good eating and are a source of food. The Chhattisgarhi name is very similar to the Bengali from which Roxburgh derived his specific name of the plant.

Scleria annularis, *Kunth.* Surya, Chhuria, *Maria*, has been twice sent from different ranges in Bilaspur as a fodder grass.

Scleria pergracilis, *Kunth.;* Baligawat, *Mar.;* Mangaligadi, *Tel.;* has been sent as a fodder grass. It is lemon-scented. Fairly common.

Scleria psilorrhiza, *C. B. Clarke*, with the same names as the last.

A more robust plant than the other two and also said to be a fodder grass. Chanda (there are no specimens at Kew from India proper and Mr. Turrill was good enough to identify the plant).

All these species of Scleria are grass-like herbs with unisexual flowers in brown spikelets, easily recognised in fruit by the pearl-white or pure-white shining nutlets, ovoid smooth ·1" long

in S. annularis and ·15″ long in Scleria psilorrhiza. In S. pergracilis the nut is under ·1″ ovoid and somewhat trigonous and tubercled.

Cyperus rotundus, *L.* Motha, Batha-bijir, *Mar.*

It is a common weed occurring as a pest in gardens. The tubers are used in the case of fever, dyspepsia and dysentery and in other diseases. They are said to be tonic and stimulant.

LXIX.—GRAMINEÆ.

[*Note.—Only the commonest and most striking grasses, and those common on the* sample grass areas, are here described. In the limitation of the genera, especially of the Andropogon group, I have followed Dr. Stapf, to whom I am indebted for assistance.]

Detailed descriptions of the glumes have not usually been given as being outside the scope of a 'list,' but identification of most of the grasses cannot be depended upon unless such descriptions are referred to. From vernacular names Forest Officers cannot expect to obtain even as much assistance in the case of the grasses as for the trees and the shrubs. They are absolutely unreliable, and on collating the names collected by myself with those recorded by Duthie (Fodder Grasses) and Graham (List of Grasses, 1913), I have come to the conclusion that practically the only really useful names are 'Mushan' for good fodder species of Iseilema and 'Gonyar' or 'Tatian' for the more or less useless grasses, generally of the genus Anthistiria and Apluda. On the utility of species for fodder my results are sometimes at variance with those of Mr. Duthie who records many species as good for fodder which I have repeatedly heard described as useless by the natives. As the people are apt to call all grass good for fodder, especially when so young that they cannot discriminate the species, and as most young grass is eaten by cattle, I think decided opinions as to the *inutility* of certain species, coupled with the fact that they may often be seen left untouched on lightly grazed areas, more valuable than contrary statements that they are good for fodder.

A.—BAMBOOS.

Dendrocalamus strictus, *Nees.* Bans, *H.* The Male Bamboo,

This is the common bamboo. It occurs principally on the hills in Balaghat, Bilaspur and South Chanda, and has been rendered very nearly extinct through over-cutting in Nagpur, Wardha and the more accessible parts of Bhandara. The two-year rotation hitherto adopted is certainly too short. The finest bamboos occur in the Sonawani Forest, on metamorphic rock.

Fls. sporadically every year in *Nov.-Dec.* Deciduous.

Bambusa arundinacea, *Willd.* Katang, Katang Bans, *H.*

A very large densely caespitose bamboo with numerous horizontal branches below which, as well as many of the other branches, are armed with recurved thorns.

Fls., gregariously and periodically.

Along muddy streams and rivers, chiefly Balaghat and Raipur, but it is found in all divisions. Rare in Nagpur-Wardha.

B.—GRASSES.

Paspalum scrobiculatum, *L.* Kodo, *H.*; Kodela (Bil.).

One to three feet high with fibrous roots and erect leaves Spikelets oval in two rows along a flat rachis.

Fls. *Oct.—Dec.*

Common, wild and also cultivated for its grain

Paspalum longiflorum, *Rets.*

Similar but with very long slender spikes and small black shiny seeds.

On the Bilaspur sample plot.

Panicum indicum, *L.* Bandarpuchli, *Vern.* (Bil.).

Stem 1—2 feet, leaves very narrow, spikelets ·1″ or less in slender spiciform inflorescences 1 – 4″ long, not confined to one side of the rachis, often purplish.

Fls. *October.*

Very common in wet places, bare of trees.

Numerous other species of Panicum occur but none of the commoner ones are typical *forest* grasses. Some like forms of Panicum prostratum, *Lamk.*, and P. punctatum, *Burm.*, occur in heavily grazed areas, the leafy stems having assumed a habit, closely appressed to the ground, which makes it difficult for animals which have no upper front teeth to grasp them.

Thysanolaena Agrostis, *Nees.* Phulbari, *Gond.*

A very large grass 5—10 feet high, somewhat resembling a miniature bamboo, with large broad flat distichous leaves often 18" by 2 and large decompound panicles, often 3 ft. by 2 ft. of innumerable minute spikelets.

Fls. *May.*

On shady slopes; but especially along ravines and water-courses in the hill forests of Balaghat and Bilaspur. It is used for brooms

Arundinella setosa, *Trin.*

A caespitose slender grass 3—4 ft. high with tufted stoloniferous rootstock, smooth stems, flat and involute setacous acuminate leaves 6—8" long on the stems and not over ·25" broad. Spklts. ·25" in unequally pedicelled pairs on slender racemes 3" long, racemes on a panicle 3—5 long.

Fls. *Sept.-Oct.*

A rather common grass on the hills. Used for brooms but not apparently for fodder.

Setaria glauca, *Beauv.* Rala, *Mar.*; Neori, *Chh.*

Spklts. in a dense terminal spike 2—3" long and ·3" thick, with numerous brown spreading bristles rising from the pedicels of the spikelets. A grass coming up spontaneously in Kodo fields and eaten, but not common in the forests. " A fairly good fodder."—*Graham.*

Fls., Fr. *Nov.*

Perotis latifolia, *Ait.* Maria, Buch, *Gond.*

A prostrate and ascending small grass branched from the foot 12—18" high, conspicuous from its long feathery spikes the slender

often purple spikelets having each two slender awns several times longer than themselves. Stem leafy with oblong-lanceolate leaves only ·5—1″ long with bristly base.

Fl., Fr. *Nov.-Dec.*

A plant characteristic of over-grazed areas on very sandy soil and not, apparently, eaten by cattle.

Coix gigantea, *Stapf.* Syn. Coix Lachryma—Jobi, *L.*, var. gigantea (F. B. I.) Rakshi, *Mar.*; Bous, *H.*, *Mar.*; Kasai, *Gond.*

A very large perennial grass 5—8 ft. high with ascending large leaves up to 1″ broad, very shortly hairy, the hairs often with tubercle base. Spikes with a solitary female in the leaf axils with or without a terminal male portion protruding from the convolute bract. This bract of the female spikelet becomes white shiny and of a stony hardness when ripe Male portion of the spike often very long-peduncled with close ternate spikelets. The large outer glumes form 6 imbricate rows and are oblong with broad wings.

Fls. *Sept.*

Along streams. Eaten by buffaloes.

Chionachne barbata, *Br.* Syn. Polytoca barbata, *Stapf.* (F.B.I.) Karpia, *Chh.*, *Gond.*; Bous, Kasai (through confusion with Coix); Rakshi (*Bil.*); Karsali, Krima jalaran, *Vern.* (f. Graham.)

A very large grass 5—8 ft. high, somewhat resembling the last, clothed below with deciduous pungent bristles. Stems straw-coloured up to ·2″ diameter. Nodes with rings of deciduous hairs. Lower cauline leaves 2—3 ft. long, ·5—·7″ wide, smaller upwards, densely hairy with tubercle-based hairs and edges spinulose.

Panicle branches several from each axil, long naked 4—12″ long bearing a foliaceous bract with several peduncles and often branches which again bear bracts, peduncles and branches of a higher order. Peduncles each with a proper obovate truncate bract with the keel ending in a *long cusp or awn*, bract many-nerved densely ciliate. The fruiting female bract is somewhat similar to

that of *Coix* but is only coriaceous and never completely closed on one side, so that the lowest joint of the articulate rachis of the spike is visible in the groove. The male portion of the spike usually consists of 3—5 prs. of spikelets only, but sometimes up to 15 spikelets occur.

A very common grass, especially on cotton soil, occurring most abundantly in blanks and open forest and becoming a nuisance after felling operations. It is useless for fodder.

Imperata arundinacea, *Cyrill.* Phulya, *Vern.*; Lotan, *Gond.*

A sub-gregarious strong-growing grass 1—4 ft. high with numerous underground stolons, erect leaves attaining their full height after flowering and fruiting and much exceeding the flowering stems, coarse, striate, glabrous, ·5″ wide. Flowering stems about 1 ft., with a closely sheathing leaf and dense, beautifully silvery-hairy spiciform panicle.

Fls. *March-April.* Usually coming up abundantly after the grass fires.

Chiefly on the Balaghat and Bilaspur plateaux, especially where wet. Also in other divisions, extending to Sironcha where it is frequent on the cotton soil

Pollinia argentea, *Trin.* Danka Chundi, *Vern.* Mothi marvel, Gunti, Vern. (*f. Graham*); Kandi (Bal. *f. Duthie*).

A tall slender tufted grass 4—5 ft. high with flat leaves 1—2 ft. long and spikelets in 5—10 shortly racemed (sub-digitate) yellow brown villous spikes with long awns, becoming silvery with age. Lower leaves 6—12″. Spikes 3·5—7″ long, spikelets geminate, close, sub-secund on the rachis.

Fls. *Oct.-Nov.* Fr. *Nov.-Dec.*

A common grass on dry or stony soil in open forest. Very common in Sihoa (Rai.) along the Silauria river, etc. Sometimes sub-gregarious on cotton soil. "Said to afford an excellent fodder when young."—*Duthie.*

Saccharum spontaneum, *L.* Kans, *H.;* Padgar, *Vern.* (*Graham.*)

A perennial grass 4—6 ft. high with stout rootstock and soily stems. Easily recognised by its long very narrow hard leaves with incurved or rolled up margins and white silvery narrow fragile panicles 1—2 ft. long with the callus hairs many times as long as the small spikelets.

Fls. *Aug.—Oct.* Fr. *Sept.—Dec.*

In swampy or wet soil and along water-courses. Also as a weed on cotton soil. Graham states that cows eat it when green and that it makes a good silage. It is sometimes used for thatching.

Saccharum officinarum, *L.*, is the sugar-cane.

Ischæmum rugosum, *Salisb.* Badaul, *Gond.;* Bhadaur, *Chh.;* Tor, *Vern.* (Nag. & Rai.)

An annual grass about 2—3 ft. high with yellowish spikes, single or mostly paired at the ends of the branches, 1—3" long. Stems often reddish and waxy below the lower nodes which have a ring of deciduous hairs. It is readily distinguished by the broad glume being glabrous at the back above and corrugated in the lower half or two-thirds.

Fls., Fr. *Oct.—Dec.*

In open ground but chiefly in fields, old 'bewars,' etc. The grain is eaten and it is a good fodder.

Ischæmum angustifolium, *Hack.* Sum, *Mar.;* Nulka Jari, *Gond.*

The 'Babar grass' of Northern India, the 'Sabai grass' of Chota Nagpur and 'Baib' of Calcutta.

A tufted often gregarious grass 1—2 ft. high with long drooping wiry leaves when old, clothed with wool at the base of the tuft. Rootstock stout. Very young leaves flat and erect soon becoming drooping and involute, ultimately harsh, and attaining 3 ft. in length with a filiform tip, glabrous except at the ciliate mouth of the sheath and the ligule of the hairs. Spikes 1—3"

long 1—4 terminating slender often branched peduncles, rachis clothed with dense yellow or brown hairs at the joints which almost conceal the spikelets. Spklts. ·16—·3″ long with hard callus and 1—2 very fine awns.

Fls. *Feby.—June.* Fr. *May—July.*

Chiefly on the rocky hills in Balaghat. Abundant in mica and horn-blende schists on the Baihar Ghats in poor forest Granitic and metamorphic hills in Sylari Khapa Forest (N. W.); Sihawa, etc. (Rai.); Ghot and Markhanda Forests (S. Ch.) on metamorphic rocks; Bilaspur, chiefly in the Lormi hills.

It probably nowhere occurs in sufficient quantities in the circle to make it important for paper, but it is largely used locally for rope-making.

Ischæmum pilosum, *Hack.* Kunda, *Vern.* (f. Graham.)

Rootstock creeping with the stolons and shoots covered at the base with dry striate leaf sheaths. Stems 2—3 ft. stout. Leaves flat or convolute. Spikes 2—6 on the stout peduncle. Pedicels and the joints conspicuously bucciniform, bearded on one face with white long hairs.

Fls. *November.*

N. Wardha; Chanda. Probably in all districts.

Graham says "a troublesome weed on black cotton soil" and "a good fodder."—*Lisboa.*

Ischæmum ciliare, *Retz.* Suhaga, *Gond.*

An erect grass or decumbent below, 1—2 ft., tufted, leafy. Leaves linear 2—4″ rarely 6″ long, the sheaths hairy with tubercled based hairs. Spikes 2—3 on the peduncle, rather stout short 1·5″ or up to 3″, lower part of the outer glumes bare and coriaceous upper part grooved and hairy. Awn of glume IV very slender only about twice as long as the spikelet.

Fls. *November.*

In sample plot, Raipur; Chanda; N. Wardha. Probably in all divisions.

Ischæmum laxum, *Br.* Sedwa, *H.*; Shara, Sheda, *Mar.*; Pendra Jadi, *Gond.*; Trla gadi, *Tel.*; Sen, *Vern.* (Bil.).

A tall perennial grass 3—4 ft. tufted on a short stout rhizome and bearing a superficial resemblance to Spear Grass. Stems straw-coloured when ripe, rather slender and constricted at the nodes with the single terminal spikes falling off entirely leaving a truncate end with a short peg-like projection (entirely different from the Spear Grass) on the stem. Leaves flat ·2—·3″ wide and about 6—12 long, scaberulous ending in a filiform tip. Sheaths striate with a ligule of silky hairs. Spikes 3 5 long with secund flat spikelets and the awns about 1·5″ secund. Pedicel of pedicelled spikelets broad flat bearded as also is the rachis, both the pedicel and sessile spikelet adpressed to and partly lying in grooves of the rachis. Outer glume of the sessile spikelet 2 keeled deeply dorsally channeled with 3 green ribs each side and two-tailed at the tip.

Fls. *Sept.—Oct.* Fr. *Nov.*

In all divisions. Common on trap in Nagpur-Wardha and a most *important fodder grass*, eaten by cattle even after the fall of the spikes, but it should, of course, be cut as early as possible. Also used for thatch.

Arthraxon ciliaris, *Beuv.* Basin, *Vern.* (Bil. and Nag) also Kakya, Leplania (f. Graham).

An annual grass with creeping stems and ascending branches 12—18″ high with short ovate or ovate-lanceolate leaves 1—3′ long and very slender peduncles bearing 2 4 short spikes ·5—1″ long with small delicate awns.

Fls. *October.*

Forwarded from the sample plot at Bilaspur, but common under shade and said to be a fair fodder.

A. microphyllus, *Hochrt* Lotna, *Vern.* (f. Graham), is very similar but a smaller plant in all respects.

Apluda aristata, *L.* Syn. A varia, *Hack.* Tatian, *Vern.* (the name is also applied to Anthistiria); Phulwer, Chidai gode, *Gond.*; Kundha, *Mar.*

A tall perennial grass, often 6—8 ft. high, with a rather stout rootstock and very leafy stems and inflorescences. Cauline leaves distichous up to 18' long, smaller upwards, ·3 1" broad setaceously acuminate, narrowed and sub-petiolate at the base, somewhat rough on the edges and sometimes with a few short hairs along the principal nerves. The small spikes, each of three spikelets, are often incurved and each is enclosed in a leafy bract (spathe) ending in an awn. The fertile spikelet also ends in a fine awn. Sessile spikelet attains ·3".

Two forms are easily recognised in which—

(1) the spikes are arranged alternately along a slender rachis. Panicle very thin:

(2) the spikes are more clustered in the axils of short leaves on the branches of a dense panicle.

Fls. *Sept—Nov.*

Common in all divisions. There is a singular consensus of opinion among the natives in the circle that this grass is quite useless either for fodder or thatch.

Roxburgh's A. geniculata is a small grass which appears to me a perfectly distinct species.

Rottboellia exaltata, *L.f.* Vern. names as for Polytoca, also Bursali (f. Graham).

A stout leafy annual grass up to 6 ft. high with leaves narrowed at the base up to 1" broad and often minute tubercles on the sheath and blade. Easily recognised by the axillary pale cylindrical stout spikes which readily break up into joints and with the green spikelets sunk in the notches. The spike ends in a point consisting of the more or less free ends of spikelets.

Fls. *November.*

Ophiurus corymbosus, *Gærtn.* Lahi, *Mar.*; Kota, *Vern.* (Bil.); Gunit, Sontha, *Vern.* (f. Graham.)

A grass 4—6 ft. high with numerous tough rush-like solid stems arising from the bulbous swellings of a horizontal rhizome. Base of stems covered with striate leaf sheaths. Leaves mostly near root, those on stem short 2—4", margin with stout ciliæ

or sub-spinulose. Spikes often purple somewhat resembling in structure those of Rottboellia but much more slender and usually fascicled in the axils of the upper leaf sheaths, often copiously but laxly panicled.

Fls. *November*.

Characteristic of damp cotton soil, especially in open over-grazed forest where, as it is often the only tall grass left, it is obviously unfit for fodder.

Andropogon pumilus, *Roxb* Diwartan, *Vern.* (f. Graham); Lal Phuyar, *H.*

An annual grass 6—3 ft high, the whole plant *turning red* in Nov. and Dec. by which it may be recognised. Leaves slender, mostly at the base, 2—3″ by ·1—·15″ with compressed keeled sheaths. Spikelets in short geminate spikes ·3—·75″ long, each pair of spikes on a peduncle about ·5″ long which is sheathed by an acuminate spathe rather shorter than the peduncle. Each spike of about three to six trumpet-shaped joints with as many pairs of sessile and pedicelled spikelets, the sessile spikelets awned. When old the spikelets fall off leaving a pair of toothed cups at the end of the peduncle. Fls. *Sept.—Oct.*, sometimes *Nov.—Dec.*

A gregarious grass very common in all divisions. On poor trap rock, often the only conspicuous grass. It flowers later on metamorphic rock with better soil. It is said to be sparingly eaten by cattle.

Andropogon intermedius, *Br.* Ghonsi (Bil.); Tamb, Bari Kandi (f. Graham), Kasi Gadi, Mular (Chanda, f. Duthie).

The vernacular names are very uncertain, both 'Kapi' and 'Rakshi' have been given in addition to the above, but these names belong to other grasses.

An exceedingly variable grass if, as seems probable, several species are not included under this name. All varieties agree in the following respects :—

Perennial grasses 3—5 ft. high with erect culms often with a ring of hairs at the nodes and narrowly linear setaceously

acuminate leaves usually 8—12″ long (much shorter in var. Grahami). Spikelets geminate (sessile and pedicelled) equal, at the nodes of slender fragile spikes which are arranged in a simple panicle or on the short branches of a compound panicle, the axils of the branches or spikes usually swollen and with a few hairs, the internodes of the spikes and the pedicels of the pedicelled spikelets densely ciliate, but the main rachis of the panicle between the nodes and its branches and the peduncles of the spikes quite glabrous. Spikelets, often purplish, ·12—·17″ long with 3-oblong glumes and a fourth reduced to an awn. Sessile spikelet with gl. I obtuse or narrowly truncate, its two keels scabridly ciliate towards the top, 4—5-nerved between the keels, margin narrowly inflexed. Gl. II as long, lanceolate or oblong, 3-nerved with smooth keel Gl. III shorter oblong hyaline nerveless Neither Glume III nor Glume IV paleate. Awn scaberulous. Pedicelled spikelet rather narrower, gl. I with the keels rigidly scabrociliate and more strongly 5—9-nerved, II 3-nerved or absent in Grahami III as in sessile spikelet, male or neuter, IV absent.

Fls. usually *Oct.—Dec.*

Throughout the area.

The following varieties are easily recognised :—

(α) genuinus.

Panicle oblong 4—7″ long with the rachis much longer than the spikes, internodes of spike and pedicel of pedicelled spikelets compressed with dark line in the centre (translucent by transmitted light). Branches of panicle with one or few spikes. Gl. I of sessile spkt. not pitted, with adpressed silky hairs below the middle but sometimes very few. Leaves on the stem usually 8—12″ by about ·25″ sometimes ciliate towards their base, sheaths smooth but with long hairs at the mouth. One form from Bilaspur has purple spikes only ·75″ long, opposite and decussate.

Another form has pale yellowish spikes 1″ long whorled above, the lower branches with more than one spike. Hackle's variety "genuinus" has spikes up to 2″ long and glume I depressed along the median nerve. From Bilaspur to Chanda.

(β) setosus, *var. nov.*

Panicle 6—8′ branches with few spikes up to 2·5′ long, whorled, glume I nearly glabrous at the back and the nerves faint. Leaves with tubercle-based stiff hairs both sides, especially below, mouth of sheath with long ciliæ

Bilaspur. Also Singbhum, a form with smaller panicle and in which the sheaths are densely setose.

(γ) *punctatus.*

Panicle 4—6′, branches with several spikes, glume I of sessile spikelet with a marked pit.

Chiefly in the eastern divisions.

(δ) Grahami, *var. nov.* (probably a distinct species, allied to A. pseudischæmun). *This differs from all the other varieties* by the 4—8 flexuous purplish spikes 1·5—2″ long greatly exceeding the common flexuous rachis and placed alternately thereon. A very coarse grass with culms woody below and much branched from the leaf sheaths, upper nodes hairy lower sheaths dry open and *persistent, leaves linear-acuminate 3—6 glabrous or with few* ciliæ towards base. Glume I of sessile spklts. with long ciliæ above as well as being ciliolate on the keels and the hairs of callus long.

Fls. *May.*

Growing gregariously in 'Bewars' in the Lormi forests, alt. 2,000 ft.

Andropogon (Dichanthium) caricosus, *L.* Var. mollicomus, *Hack.* Belia, *Vern.*

A stout or perennial leafy grass 3—4 ft., erect or decumbent below, rather swollen above the nodes and the lower internodes grooved on one side, the upper nodes bearded. Leaves, erect on stem, 6—8″ ending in a filiform point, with a few long hairs above the striate compressed sheaths, margins scabrous. Spikelets broad, closely imbricate in 4 rows along the rachis of 2—5 spikes which are 2 3·5 long and have very hairy short peduncles arranged in a very short raceme, looking like the inflorescence of Ischæmum.

The sessile spikelets, which are on one side of the spike, are awned. Glume I obovate or oblong 5—7-nerved, the margins incurved and the two keels with *ciliate wings*

Fls. *Oct.—Dec.*

All over the western districts in grass Birs, etc. Also Bilaspur, so that it probably occurs in all divisions. [The C. P. plant is stouter than the specimens from the southern part of the peninsula and Ceylon and I have never seen it with solitary spikes, var. genuinus, *Hack.*]

Sorghum halepense, *Pers.* Syn. Andropogon halepensis, *Brot.* Bhara, *H.*; Bhoru, *Mar*; Jalaram, *Gond.*

A very large perennial leafy grass with a creeping rhizome, 5—8 ft. high or even up to 15 ft. in some localities, the long broad leaves with prominent white midrib and scaberulous margins glabrous except near the ligule which is itself very short or a row of short hairs. Panicle 8—18" long, more or less pyramidal, not dense, with long solitary or 2—3-nate slender branches 2—4" long bearing spikes with only 3—4 pairs (sometimes only a triplet) of spikelets, axils of branches tumid or ciliate, joints of rachis and pedicels margined ciliate. Sessile spt. ·12—·2" long and glume I appressed silky faintly 6-(5—11)-nerved.

Fls. *Nov.—Dec.* Fr. *Dec.—Jany.*

Locally along damp valleys, especially along the banks of muddy streams. Common in the valley of Ar nadi, Arvi range (N. Wardha); very common along rivers in Gaikuri range (Bh), where it attains 15 ft.; dense along the rivers about Nawapara, Laon range (Rai.); Allapalli (S. Ch.). It is therefore generally distributed.

Eaten by cattle and sometimes said to be a *good fodder* but, like S. vulgare, is apt to develop, under certain conditions, a poisonous glucoside and is sometimes said to be poisonous till after the rains (*vide* Dr Leather in Agricultural Ledger). Grain sometimes eaten, and it is believed to be the ancestor of the cultivated 'Jowar.' Stems are used for making pens.

Sorghum vulgare, *Pers.* Syn. Andropogon sorghum, *Brot.*, is the cultivated 'Jowar.' After cutting the new shoots (Karbi) form a most useful supply of fodder, especially in the Western districts, the abundance, or otherwise of which has an important effect upon the sale of grass from the forest.

Sorghum serratum, *Haines.* Comb. nov. (As there is a previous Sorghum serratum, *Roem. and Schult.* = Panicum serratum, this name should perhaps be abandoned.) Syn. Andropogon serratus, *Thunb* (1784). Holcus fulvus, *R. Br.* Prod. (1810). Sorghum fulvum, *Beauv.* (1812). Rathar. *Vern.* (Bil.)

A tall tufted perennial grass 5—6 ft. high, villous at the nodes and with the leaf sheaths villous on one side, leaves with long hairs at the base and often hairy on the surfaces especially beneath. An easily distinguished grass with brown or black shining spikelets in short spikes at the end of filiform sub-whorled branches which are arranged in a sub-simple oblong panicle 6—9" long. Rachis of the spike bearded with brown hairs. Glume IV of sessile spikelet hairy with a long bent awn, or awn obsolete.

Fls. *Oct.—Nov.*

Usually in rocky open forests from Bil. to Chanda.

Sorghum purpureo-sericeum, *Schweinf.* Syn. Andropogon purpureo-sericeus, *Hochst.*

Somewhat similar to the last but has larger more shaggily hairy spkts. with white or red-brown hairs, sessile spkts. ·3" long (only ·17" in last).

Fls. *Oct.—Nov.*

Less common. Chanda.

Vetiveria zizanoides, *Nash.* (in Small, Fl. S. E. U. S., 1903) and *Stapf* (Kew Bulletin, 1906). Syn. Andropogon squarrosus, *L.f.* Kas-Kas, *H.;* Ururi, *Mar.;* Ursuri, *Gond.;* Vetever is the South Indian name.

A tufted perennial grass 3—5 ft. high with stout spongy aromatic roots and rather rigid sub-erect glabrous leaves 1—2 ft,

long with scabrous margins. Panicle 6—12" with many-whorled spreading or ascending branches each terminated by a long many-jointed spike. Joints and pedicels filiform with truncate not bearded tip but base of sessile spkt. slightly bearded. Easily recognised by the muricate keels of glumes I and II, glume IV not or very slightly awned.

Fls. *November.*

Chiefly on low ground and abundant about the damp ground surrounding tanks. The roots form the well-known scented material from which Kus-Kus tatties are made.

Chrysopogon monticola, *Haines* Comb. nov. Syn. Andropogon monticola, *Schult.* Mont. (1817), Crysopogon montanus, *Trin* in Sprengel (1820). Malha, *H.;* Tarali, Putku Jadi, *Gond.;* Pandri Ban, Sain, Chirra, *Gondi, Chh.;* Pedha Bhusar, *Tel.*

A variable grass best described under the two forms given below. They agree in the panicle consisting of very slender often flexuous whorled or sub-whorled branches which end in a clavate obliquely truncate and cupped bearded tip (best seen on the fall of the spike), and in the single terminal spikes consisting each of only 3 spikelets, 1 sessile and 2 pedicelled, the pedicel of the pedicelled spkt. not half as long as the sessile spikelet.

Fls. *Sept.—Nov.*

(α) *monticola* proper.

Slender tufted grass 1—2 ft., leafy below, base often decumbent, leaves short, 1—2" acute or obtuse, glabrous, lower sheaths compressed. Panicle 2—3", the main axis filiform above. Spikes about ·2" long, often purple, with brown hairs on the rachis and pedicels. Awns (of glume IV) 1·3" long. Pedicelled spkts. with or without awns.

(β) Var. robustus.

Erect, stout, 3—5 ft. Base of stems densely covered with compressed leaf sheaths. Leaves 6—12" often with long ciliæ at base with tubercled bases. Panicle 4—6", main axis filiform above. Spikes about ·3" long with dense brown hairs as in the last. Awn (of glume IV) 1·5—2" long. Pedicelled spkts awned.

Both forms are very common, especially on cotton and trap soils. On sandy soils the larger variety has not been observed, but the smaller is common. Grass on laterite often contains a large percentage of C. monticola and Spear Grass. Soils with white clay, when not too heavily trampled grow C. monticola in association with Apluda and Anthistiria. A fodder grass when young, but from its abundance on grazing areas it would appear not to be one of the favourite grasses.

Heteropogon contortus, *Beauv.* Syn. Andropogon contortus, *L.* Sukla, Kusal, *Vern.* (in all districts); Hukda jadi, *Gondi*; Tede gadi, *Tel.*; Spear Grass.

A perennial leafy tufted grass 1—4 ft. glaucous when young, compressed below and with often keeled sheaths. Leaves 6—18 long by ·15—·25" broad, scaberulous above and the margin scabrid. Spikes singly 1·4—3" long ending in the twisted ends of the awns, Lowest several pairs of spikelets male or neuter, imbricate, not awned, and usually persistent after the fall of the fertile spikelets. Upper spikelets heterogamous, the sessile ones fertile with awn 3—5" long, the pedicelled ones with very short pedicel and more or less concealing the fertile, all with long white tubercle-based hairs. Base of fertile spikelets with a hardened point and a barb of hairs.

Fls. *Sept—Nov.* Fr. *Nov.—Jany.*

Common in all divisions, especially luxuriant on cotton soil.

Frequent on sandy soils, in valleys and also found on laterite. Thrives on a sandy loam. Is a useful, though not first class, fodder if cut before flowering. It is also eaten by horses and some cattle after flowering, but the fertile spikelets should be cleaned out or they are apt to produce sore mouths.

A good thatch grass.

Cymbopogon Martini, *Stapf.* Tikari, *Gond.*; Rusa, *H.*; Motia, Sofia, *Mar.*; Sirra, *Chh.*, Lemon Grass.

A stout tufted leafy grass with strong short rootstock.

Base of stems usually bare (not covered with imbricating bases of leaf sheaths), woody. Leaves glaucous or pruinose beneath,

narrow or attaining 1·3″ broad, the base never narrowed, often cordate or amplexicaul. Spikelets paired in short geminate spikes the common peduncle of which is much shorter than the spathe from which it arises, pairs of spikelets in elongate strict or branched panicles, usually *sweetly scented*, spathes and often leaves always turning reddish or red with age (hence the name *rusa*).

Fls. *Oct.—Feby.*

All districts, chiefly on rocky hills, also found on cotton soil, but nowhere sufficiently abundant to render the extraction of the oil remunerative, though small leases for its collection are occasionally given.

Two varieties are distinguished by the oil distillers, 'Sufia' giving a good oil and 'Motia' which is worthless. These do not correspond to any structural differences in the plants so far as I can ascertain, and plants with both vernacular names are included under the same variety at Kew.

Graham (List of Grasses, Nagpur and Telinkheri) quotes Andropogon Nardus, *L.*, as common No description however is given except that the leaves are narrow and it has no smell. I have never found A. Nardus nor any other oil grass of this section, but Cymbopogon Martini, *Stapf.* sometimes has narrow leaves and is nearly scentless (Motia ?).

Stapf (Oil Grasses, Kew Bulletin, 1906) states that Cymbopogon Nardus is only known in cultivation.

Anthistiria imberbis, *Retz.* Bhond, *Vern.* (Bil.), Goniar, *Vern.*

A large leafy, often branched, perennial grass 2—5 ft. high. Leaves 3—10″ glabrous or sparsely hairy with short ciliolate ligule. The spikelets are clustered in bracteate sub-globose or flattened heads which excluding the awns and long acuminate tip of the spathes are about as broad as long. The heads are arranged in large leafy lax panicles. Spathes compressed with bulbous-based setæ along the edges or glabrous. Each head contains several small spikes each with its one small spathe. Each spike has a curious envolucre of four male spikelets, a central fertile spikelet

and two male pedicelled spikelets. The pedicelled spikelets are half as long again as the fertile which is polished, white or brown, grooved, cylindrical, hispidulous with short brown hairs at the tip, from which projects the long 2" awn, the base is long and pungent.

Fls. *Sept.—Nov.*

Common from Nagpur to Bilaspur.

Anthistiria ciliata, *L.f.* Goniar, Gunhar, *Vern.* (all districts), Birain, the variety with fan-shaped fascicles (Bil.); Lel Gondali (S. Ch.); Tara Gola Jadi, *Gond.;* Tera Gola Gaddi, *Tel.*

A rather short stout leafy, often very gregarious, grass 4—5 ft. tufted from a rather stout (annual?) rootstock, easily recognised from the clusters of spikelets being arranged racemosely on *short erect usually paired* branchlets, the panicles simple above with alternate clusters. The involucral spikelets are copiously fascicled on the back with tubercle-based hairs. Glume I of the fertile spikelets wraps round glume II and is uniformly clothed with sparse very short appressed hairs and minutely dotted, base not pungent but with an oblique scar.

In the F. B. I. it is stated that it very often resembles the ordinary states of A. imberbis but the above form is unmistakable. A form with more fan-shaped fascicles occurs, but it is rarer.

Fls. *Oct.—Dec.*

In all divisions. It is sometimes densely gregarious over large areas (*e.g.*, in the grassy tracts about Nawapara in the Laon range).

It is unfortunately useless either for fodder or thatching although Graham (quoting Lisboa) says "Good fodder and hay" and Duthie says (under 'A. scandens') "Used for fodder and for thatching purposes," but it is possible that there is a mixture of species under A. ciliata

Anthistiria laxa, *Anders.* Tatian, *Vern.* (in many divisions); Charha, *Chk.;* Tera Bhusar Gaddi, *Tel.;* Ginari (N. W.) Goniar (Bal.).

*This is also a very distinct species being a tufted slender, 2—4 ft. high, much branched grass, feathery from the numerous short soft narrowly linear leaves and with many lax leafy panicles of sub-solitary or few small heads on filiform branches. Lower leaves on main stem up to 12", upper 2—4" by ·1" ending in a filiform tip, with few long white soft hairs near the base, sheaths compressed striate, keeled. Heads about ·5" diameter. Spikelets of involucre ·2", often reddish, with green glabrous callus, finely ribbed, few long tubercle-based hairs towards the tip. Glume I of fertile spikelet deeply grooved on back. Awn 1·2" long.

Fls. *Oct.—Nov.* Fr. *Dec.* (when the clusters usually turn red).

All divisions; very abundant in the western divisions, often associated with the last, but preferring more sandy moist situations. Gregarious about 4 ft. high over large areas, as in the B class forests about Mukri (S. Ch.). Luxuriant on sandy black cotton ('Bersi Kanhar') soils where the dominant grasses are often A. laxa and A. ciliata with smaller quantities of the Iseilemas. Good for fodder when young only.

Anthistiria gigantea, *Cav.*

A very large stout grass up to 10 ft. high and of very different habit from all the last, with flattened stems and leaves 2—5 ft. by ·3—·7". Spikes few in pedicelled drooping clusters terminating the branches of the very large lax panicle, the involucral spikelets are arranged in superposed pairs instead of as a whorl, the 2—3 fertile spikelets in each spike are rufously hirsute.

Fls. *Nov.—Dec.*

Only remarkable from its size, as it only occurs in a few nalas and ravines in Balaghat and Bilaspur, where it is a pest from the pungent barbed fruiting spikelets.

Iseilema laxum, *Hack.* Mushan, *Mar.*; Mucheli (Bil.); Menchi Malwa Jadi, *Gond.*; Gurap Malwa, *Tel.*

A very common tufted grass with strong fibrous roots, about 1—3 rarely 4 ft. high, leafy with short leaves, the lower only

4—5·5′ and often much shorter, acute or obtuse, about ·15″ broad with a strong keel, usually with long ciliæ below and on the compressed sheaths but nodes only hairy towards the inflorescence. Inflorescence of few or many lax narrow panicles consisting of flattened leaf sheaths and their progressively smaller blades bearing fascicles of small peduncled spikes each with their own proper spathe. Proper spathes about ·3′ long boat-shaped with scarious margins with the peduncle of the spike ·1—·15′ long above base of spathe articulate above the spathe and again at the base of spike. This spike consists of an involucral whorl of 4 male spikelets round a central internode bearing sessile, 2-sexual, and 2-pedicelled, male, spikelets. The whole involucre falls off at the articulation below its base (whereas in Anthistiria it is persistent). Sessile spikelet ·2″ bottle-shaped, the glume I narrowly lanceolate 5 nerved upwards and 2-cuspidate (or the two excurrent nerves sometimes united by a thin membrane).

Fls. *Oct.—Dec.*

In all districts but more especially in Nagpur-Wardha and North Chanda on cotton soil. Prefers cotton soil overlying sandstone. It is said to be the best fodder grass in the circle and is largely eaten by cattle green or dry.

[*Note.*—The proper spathes and spikelets are often minutely pubescent

In another variety the margins of Glume I of all spikelets has long white ciliæ.

White ciliæ are always present at the base of spike and its nodes. The edges of the sheaths are frequently furnished with long tubercle-based hairs, cp. I. Wightii.

Two common states occur—(*a*) Dwarf, leaves short obtuse, panicle very lax, not at all leafy as the clusters of spikes are remote and their subtending leaves with very short blades; (*b*) Taller and more tufted. Panicle leafy.]

Iseilema Wightii, *Anders.* Mushan, Ghod or Ghora Mushan (in the western districts); Malwa jadi, *Gondi*; Malwa Gaddi, *Tel.*

A tufted very leafy grass 3—4 ft. high with rather short fibrous roots, perennial? Nodes with a ring of hairs. Leaves erect radical fading 12—15′, cauline from 10″—3 and mostly under ·12″ wide, strongly keeled, scaberulous above and on edges, with long hairs towards the base and sheaths often copiously white hairy with long

tubercle-based hairs, ligule of close long hairs. Panicle strict, or more often, with copious short side branches, the panicle leaves bearing the spikes, as well as the proper spathes of the spikes, being characteristically furnished along the keels and along the edges with rows of small tubercles. The structure of the spike is as in the last species but (when in full flower) it is much further exserted from its proper spathe, is usually of a characteristic purple colour, the two pedicelled spkts. project further (often for their whole length) from the involucre and all the outer glumes are very strongly ribbed and often scabrid and sometimes even furnished at the back with the characteristic small tubercles. Base of spike with a ring of white hairs like all the other nodes of the plant. The involucral spikelets are always shorter than in I. laxum, being only ·12" whereas they are always over ·15" in the latter species.

Fls. *Oct.—Dec.*

Not so common as the last in the western districts but the commoner species in the eastern districts. Frequent on metamorphic rocks as well as on cotton soil.

An excellent fodder and opinions differ as to the relative merits of these two grasses.

Aristida setacea, *Retz.* Jhani, *Vern.* (Chanda).

A slender perennial grass 3—4 ft. high with very slender convolute leaves 9—20" long and panicles of very narrow spikelets with barbed fruits and 3-fid long awns. Branches of panicle capillary, 4—5 from each node of panicle, secund, scabrid. Spikelets ·3", branches of awn ·7—1", scabrid.

Fls. *Oct.—Nov.* Fr. *Nov.—Jany.*

On sandstone and a pest of over-grazed areas on sandy soils.

Several other species of Aristida occur, *e.g.*, A. redacta, *Stapf.*, with thin, not secund, panicles and the awn 3-fid high up, instead of at the base. A. Hystrix and A. Cumingiana, *Trin.* The last is characteristic of sandy soils in Raipur and is one of the plants called 'Barbhusi' (*vide* Eragrostis). It is much more elegant than the other species of Aristida, with reddish panicles and small spikelets, also with delicate 3-fid awns.

All of these are useless pests.

Phragmites Karka, *Trin.* Nal, *H.*

A very large grass 10—20 ft. with wide spreading stolons and jointed hollow leafy stems. Leaves distichous about 16" by 1" rather rigid, with subulate tip. Panicle 1—2 ft. very compound, usually grey or purplish with innumerable linear spklts. with several glumes, axis of spikelet jointed between the glumes and with long silky hairs.

Fls. *Nov.—Dec.*

Along sandy nalas and rivers but not very common in the Southern circle, Makhari valley, Parawara range, and other valleys in Balaghat; S. Sihawa (Rai) common.

Eragrostis tenella, *Roem.* Chipad, *Gondi,* and its var. plumosa and Eragrostis interrupta, *Beauv.*, are the grasses usually known as 'Barbhusi' or Chhota Barbhusi. Slender delicate grasses with several panicles of small often purple spikelets composed of several small ribbed glumes and frequently long ciliæ at the nodes of the panicle.

E. interrupta var. tenuissima has linear-oblong panicles sometimes over 12" *long with interrupted whorls of short branches.*

Fls. *Nov.—Dec.*

Gregarious, and characteristic of over-grazed heavily trampled areas, on clay, quartzite and other metamorphic rocks, especially in Raipur. They are thickly covered with drops of dew on cold weather mornings and in the hot weather are dangerous carriers of fire, burning like tinder and often extending over fire-lines where, on account of the dwarf habit of these grasses, the lines have not been burnt.

E. tenella, var. viscosa, *Stapf.*, a very tufted form is viscid and has a distinct smell which may be detected when walking through the grass. The panicle is dense and often purple.

Other species of Eragrostis occur but have somewhat different habit and are unimportant E. tremula is a very pretty grass 1—2 ft. high with the linear inclined spikelets often composed of over 30 pairs of glumes.

Cynodon dactylon, *Pers.* The Dub grass, only occurs near a few nalas with sandy loam.

A PLEA FOR THE DISTILLATION OF PINE-NEEDLE OIL IN INDIA.

BY PURAN SINGH, F.C.S.

Introductory.

The distillation of oil from Pine-needles in Europe and America is now an established industry. A brief account of this industry in America appeared recently in the *Scientific American* of 7th February 1914 (see below). Another illustrated account of this industry as carried on in Sweden appeared in the "Special Tar and other Wood By-products" number of the Journal published by the Swedish Chamber of Commerce in London, Vol. V, No. 8 of August 15th, 1913. It was the latter account which drew the attention of the writer to the possibility of profitably distilling oil from chir-pine needles in India.

General composition and varieties of the Pine-needle oil.

The Pine-needle oil is distilled in Europe and America from the Pine-needles and small twigs. The following particulars about different kinds of Pine-needle oils are taken from "Gildmeister and Hoffmann, Die atherischen ole, Zweite Auflage, Band II." Those of *Abies pectinata*, DC., are employed in Switzerland, Tirol and Austria. The oil obtained from this species has a sp. gr. of 0·867—0·875, an optical rotation of $-34°$ to $-60°$ and gives 8 % at 170°C. and 55 % between 170 and 185°C. In Norway, the needles and young twigs of *Picea excelsa*, Lk., are employed. The yield is 0·15—0·25 %. Its sp. gr. is 0·880—0·888, and optical rotation from $-21°40'$ to $-37°$. On fractional distillation, it gives 20 % at 160°—170°C, and 50 % between 172 and 185°C. Umney, however, obtained the following results for this oil:—

163—173°C.	...	...	41 %
173—176°C.	...	...	16 %
176—185°C.	...	...	13 %
185—220°C.	...	...	14 %
Residue above 220°C.	...	...	16 %

In Eastern Austria, in the Alpian regions and especially in Tirol, the needles and young twigs and small branches of *Pinus montana*, Mill., are employed. The yield is 0·4 to 0·45 %. The

oil has sp. gr. of 0·863—0·875 and the optical rotation of $-4^\circ 30'$ to -9° On fractional distillation, Umney obtained the following figures :—

155—165°C.	...	...	2 °/₀
165—180°C.	...	...	59 °/₀
180—200 C.	...	...	21 °/₀
Residue above 200°C.	...	...	18 °/₀

In Germany, the oil is obtained by distillation from the needles of *Pinus silvestris*, L. Messrs. Schimmel and Co. obtained from fresh needles a yield of 0·55 °/₀ in July and 0·45 °/₀ in December. The German Pine-needle oil has the sp. gr. of 0·865—0·886, the optical rotation of $+ 5^\circ$ to $+ 10^\circ$. On fractional distillation, the oil gives the following fractions :—

160—170°C.	...	...	10 °/₀
170—185°C.	...	...	46 °/₀
Residue above 185°.	...	...	44 °/₀

Besides these there are many other similar oils which come under the collective name of Pine-needle oils, of these two more may be mentioned here.

The Swedish Pine-needle oil agrees in its general properties with the German needle oil. It has sp. gr. of 0·872 and the optical rotation of $+ 10^\circ 40'$ and gives on fractional distillation 84 °/₀ up to 185°C.

The English Pine-needle oil is obtained by distilling the needles of "Scotch fir." It resembles the German oil in all its properties except that it is lævorotatory. Umney obtained 0·5°/₀ of oil in June, 0·133 °/₀ in December on distilling the fresh needles. The sp. gr. of this oil was 0·885—0·889. The optical rotation ranged between $-7{\cdot}75^\circ$ and -19°. On fractional distillation, the oil distilled in June gave 71 °/₀ up to 252°C. and that distilled in December 63 °/₀ at the same temperature

In their general composition, the German, Swedish and English Pine-needle oils consist of l—α—Pinene, Dipentene, and Sylvesterene, while others contain l-phellandrene, l—limonene, and some undetermined Sesquiterpenes in addition.

These oils are generally adulterated with cheap turpentine oil. Messrs. Schimmel and Co., in their semi-annual report, April 1914, refer to a series of tests carried out by C. Th. Morner on oils from the needles of conifers, who found that of twenty-eight samples of commercial oils examined, only fifteen could be described as of good quality. They say that turpentine oil is very commonly used as an adulterant. Such adulteration cannot be detected by isolating the pinene, because pinene is a normal constituent of all the oils from conifer needles; detection is only possible when turpentine is added in considerable quantity, owing to the fact that the oil fraction with the boiling point below 165°C. is larger in proportion than is the case with pure oils.

A brief description of the industry in America.

The following extract from the *Scientific American* of 7th February 1914 gives a brief and general description of the industry as being now carried on in America :—

"Pine-needle oil is a product derived from the leaves of our pines. It has been extracted for a great many years, and it is well known the world over as a remedial agent against rheumatism and allied complaints. It is a volatile, colourless liquid obtained by distillation of fresh needles, young twigs, and one year old cones of our western and southern yellow pines. In order to produce oil of the best quality, fresh green needles must be collected during the spring of the year, preferably in the beginning of June. Pine-needle pickers go from tree to tree and select the young thrifty green leaves at the ends of twigs, which yield about 0·55 % of volatile oil. Those of old trees, which are dry and tough, produce much less and of much poorer quality.

"A number of years ago, this oil was supplied by a number of small stills or ordinary pharmaceutical distilleries. The still itself is a very simply constructed apparatus consisting of a closed copper kettle, into which the material is placed. Steam is admitted under pressure and passed through the contents from the bottom of the kettle. The volatile oil is vapourised by the dry steam and passed off with saturated steam through a long coiled

condensing tube. The condensed steam and oil are collected in a receiver and the oil, which is on top, is drained off.

"There has been an increasing demand for pine-needle oil and the small stills which could not compete with the larger concerns practically all ceased to operate. The large distilling plants with all the recently introduced secret devices are now able to produce all the oil required for home consumption and also for export. In this way the oil has not only been improved but the cost of production has been considerably diminished. Some of the large stills have a capacity of from 30,000 to 60,000 gallons annually. The price of purified oil varies from $20 to $30 a gallon. Cheaper oils are frequently adulterated with turpentine oil. The mass left in the kettle after all the oil has been driven off may be regarded as a by-product, and it is sometimes due to the close utilisation of this material that the business is made a profitable one. The needles are removed from the kettle and boiled in a soda solution until all the resinous matter and non-fibrous tissues are separated from the fibres. It is next passed through a series of washing, drying, and heating processes, which sometimes require twenty-four hours. After they are put into a machine to separate and loosen the fibres, they are bleached and put in assorted packages and sent to the different markets, where they are sold for pillow and mattress stuffing. The fibre will retain its odour permanently and is considered very helpful and vermin-proof. It was on account of these two qualities that the best hotels and hospitals of Europe used this fibre in their mattresses.

"The material when properly prepared is sometimes known as pine wool which may be spun and woven into fabrics. It is very strong and is advantageously employed for many purposes for which hemp is used. In Europe this pine wool is made into jackets, drawers, and stockings of every description as well as flannel for shirts, cover-lids and chest protectors. Knitting and darning yarn, quilts, wadding, deafening paper for walls and floors, and a great many other articles are manufactured from this wool."

Chir-Needle Oil. Yield and constants

In August 1913, the writer distilled 90 lbs. of fresh Chir-needles with short twigs containing 59·30 % of moisture by steam at a pressure of 10—15 lbs., which gave 0·57 % of the oil, or 1·4 % calculated on the dry material. This oil gave following constants :—

Sp. gr. at 20°C.	0·874
Optical rotation in 100 mm. tube ...	– 6° 15′
Acid number	1·03
Saponification number (milligrams of KOH. per one gram of oil)	15·54
Iodine value (Hubl 18 hours)	271·2

On fractional distillation in an ordinary distillation flask at Dehra Dun, it gave the following fractions :—

160—165°C.	23·8
165—170°C.	29·0
170—180°C.	19·8
180—200°C.	15·1
200—215°C.	6·7
Residue above 215°C.	5·6
	100·0

The sp. gr. and the optical rotation of the five fractions are given in the following table :—

No. of fraction.	Sp. gr. at 20°C.	Optical rotation in 100 mm tube.
1	0·86	– 12° 12′
2	0·861	– 9° 15′
3	0·863	– 6° 0′
4 ...	0·868	– 3° 0′
5	0·909	– 2° 0′

From the above constants, it is evident that as a "Pine-needle oil," the Chir-needle oil is of standard composition. It must therefore have medicinal properties similar to other Pine-needle

oils. A proof of its efficacy has been received from Major Cochrane, I.M.S., of the Bhowali Sanatorium to whom Mr Pearson kindly sent a sample for a trial. Major Cochrane gave it to his patients suffering from consumption, who found that it gave them relief.

The prospects of the industry in India.

The Chir-needles can be had in large quantities from the areas of our forests under felling operations. At the request of the writer Mr. Pearson, the Forest Economist, kindly sends him the following data on the quantity of Chir-needles that can be had per tree of over 4' girth. He weighed the needles of six Chir trees. The needles were quite green and cut from the trees together with short twigs. The results were as follows :—

Serial No.	Girth of bale	Length of stem.	Weight of green needles and small twigs in lbs	REMARKS.
1	5' 5"	75'	1,005 lbs.	A fine grown tree with good crown.
2	5' 8"	70'	157 ,,	A poorly grown tree branching from the base
3	4' 8"	58'	336 ,,	
4	3' 6"	49'	196 ,,	
5	4' 5"	68'	366 ,,	
6	4' 4"	74'	232 ,,	
		Total ...	2,292 ,,	

Average 282 lbs. per tree.

At the time when these weights were taken, the new needles were not fully developed, thus Mr Pearson is of opinion that the average may be taken as 400 lbs. per tree of 5 feet girth.

He further says that Jaunsar could annually supply needles from about 2,000 trees and the Kumaun Circle from about 20,000 trees which are felled for sleeper conversion. If a tree produces 400 lbs of needles yielding 0·57 of oil, then the Kumaun Circle of U. P. could alone produce 45,600 lbs. of oil or about 5,000 gallons.

To begin with, it will not, however, be possible to handle this quantity. It will be necessary to divide up the work between a number of small portable distilleries put up in convenient positions as regards their proximity to the felling areas. A typical distillery would be one with an annual output of 300 gallons.

The plant required would consist of one portable boiler of 5 N.H.P. and a battery of two stills worked by it, each still having a capacity of 400 lbs. The total plant would cost about Rs. 6,000. In a day of ten hours, it will be possible to operate two charges at least. Thus 1,600 lbs. of needles distilled in ten hours would give 9·12 lbs. of oil per day or about 25 gallons of oil per month of 25 days. The cost of production of 25 gallons may be roughly reckoned as below :—

	Rs.
One boiler man	80
One fireman	20
Labour of collecting, etc.	100
A Ranger in charge	150
Fuel	150
Cartage of 25 gallons of oil to the market ..	20
Interest on Rs. 6,000 at 6 % per annum ...	30
Depreciation at 5 % on the capital	25
Extra charges	25
Total ..	600

Thus the cost of production may be roughly said to be Rs. 24 per gallon delivered at the market in gallons. Taking lowest price of needle oils as given above in the quotation from the *Scientific American*, at Rs. 60 a gallon, we might expect on this basis a revenue of Rs. 10,000 a year. In other words, a tree should yield Rs. 9 from its needles and short twigs. This does not of course take into consideration the value of the by-product which might be sold in India for filling pillows, mattresses, etc. In fact the sweet pine odour of the article would make it a welcome filling agent.

The consumption of the oil is on the increase. In Europe it is required for sanatoria, baths and health resorts as well as for rooms, sprays and various patent air-purifiers.

With the increasing attention that is now being paid to sanitation in this country, it seems quite possible that a good market for the article might be created in India if its useful properties are well advertised and brought home to the people. It is well known that the disease of consumption is widely prevalent in the country as the establishment of more than one sanatorium clearly indicates. But the people do not generally take to sanatorium life in the early stages of the disease or most of them have not the means to do so. It would, therefore, be a great boon to the people if they could have the Pine-needle oils placed within easy reach.

The industry must be necessarily a departmental one to avoid all sophistication of the oil on the part of the trading manufacturer. The Forest Department would be doing not only a good business, but a good service to the people. The co-operation of the Medical and the Sanitation Departments would be required to advertise its medicinal value and we might hope to see the Chir pine-needle oil kept in stock by every Indian druggist as is done in the case of oils of peppermint and thymol and other popular medicines of general use.

Conclusion.

We would like to see the figures given above confirmed by a fairly large scale trial either in the Jaunsar or in the Kumaun Circle.

THE HEIGHT OF ELEPHANTS.

BY E. R. STEVENS, I.F.S.

In the July number of the *Indian Forester*, Mr. T. W. Forster gives us an interesting record of the measurements of a wild tusker shot by him in the forests near Mansi.

Evans, in his Treatise on Elephants, says :—

> "We may take it on the authority of Sanderson, a most careful observer, who had unrivalled opportunities of investigating such matters, that such a thing as an elephant measuring ten feet at the shoulder does not exist in India, nor I may add in Burma. The largest male he ever met with measured 9 feet 10 inches."

The measurements of Mr. Forster's elephant as well as those taken of a wild tusker recently shot in the Ramnagar Division, U. P., dispose of the theory that elephants do not attain a height of 10 ft. at the shoulder.

Unfortunately I did not take so many measurements of the Ramnagar tusker as Mr. Forster did of his specimen. The few measurements were, however, carefully taken and show that this tusker was equally large and had finer tusks. I do not know if the size of these two elephants is abnormal as compared with that recorded of others, but feel confident that I have seen two bigger tuskers in the wild state, one in the Ramnagar Division and another in the Haldwani Division of the U. P.—both solitary tuskers.

The measurements of the Ramnagar specimen are :—

	Ft.	in.
Height at shoulder between stakes ...	10	4
Circumference of near forefoot	5	1½
Height calculated at twice circumference of foot	10	3
Right tusk. Length—Outer curve—(showing)	4	2½
" " " (in skull)	2	1½
Full length—Outer curve ...	6	4

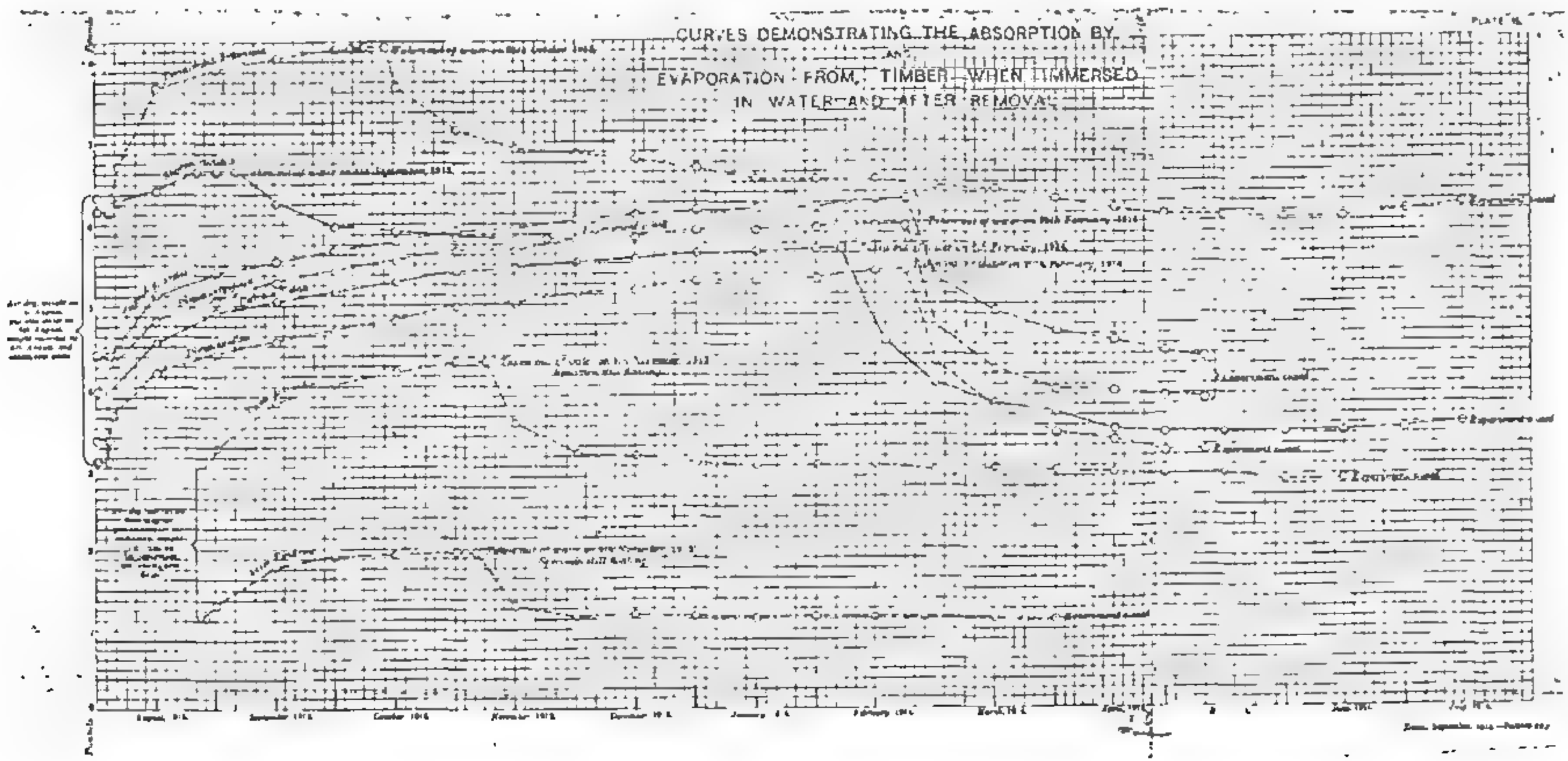
	Ft.	in.
Girth	1	4⅝
Weight	56	lbs.
Left tusk. Length—Outer curve (showing) ...	4	2⅛
" " " (in skull) ...	2	1
Full length—Outer curve ...	6	3⅛
Girth	1	4¾
Weight	56	lbs.

[illegible] tusks were weighed by a spring balance of which the [illegible] of the scale *did not allow of very accurate weighment* [illegible] they each raised the lever to just below the 60 lb. mark and together to midway between the 115 lbs. and 110 lbs. marks so they closely approximate 56 lbs. each as entered above.

It is worth noting that the proportion of length showing to length in skull corresponds very closely to 2 : 1 as in the case of the tusks of wild boar.

In Mr. Forster's specimen this proportion does 'not hold good, there being more than one-third of the total length within the skull. Perhaps it may be concluded from this that his specimen had not yet reached maturity.

With regard to the proper treatment of tusks to prevent them cracking I should be grateful for advice both as regards the external surface of the ivory and the large basal cavities. Presumably the large cavities should be filled up with something and it occurs to me that *for this purpose conical cores of wood* imbedded in paraffine wax, bees'-wax or putty might be suitable.


CURVES DEMONSTRATING THE ABSORPTION BY AND EVAPORATION FROM TIMBER WHEN IMMERSED IN WATER AND AFTER REMOVAL

NOTE ON THE ABSORPTION OF WATER BY CERTAIN TIMBERS.

BY R. S. PEARSON, I.F.S., FOREST ECONOMIST.

An experiment was started in August 1913 with a view of determining the amount of moisture absorbed by certain timbers when completely immersed in water. The experiment was carried out with a twofold object, *i.e.*, to ascertain which timbers would respond to treatment with antiseptic in open tanks and what the effect would be of immersing timber in water and afterwards subjecting it to air-drying in order to hasten seasoning. Incidentally the behaviour of the Spruce and Silver fir specimens was observed in connection with water-logging.

In order to carry out the experiments squares 1′ × 4″ × 4″ were carefully prepared of all species except Silver fir and Spruce, the size of which was 1′ × 2½″ × 2½″ and 1′ × 3½″ × 3½″ respectively. The species with which the experiments were carried out were *Pinus excelsa* (Kail), *Pinus longifolia* 'Chir', *Abies Pindrow*, *Picea Morinda*, *Cedrela Toona*, *Terminalia tomentosa*, *Shorea robusta* and *Tectona grandis*, the latter two being added more for the sake of comparison and as standards than for experimental purposes.

The method of carrying out the experiment was in each case to weigh the specimens before immersion, then immerse them in water, weigh them every day, calculating to two decimals of an oz., and when they had absorbed water to their maximum capacity and shown constant readings on several consecutive days, to take them out of the water and allow them to dry in an open shed. They were then weighed every day until they again showed constant readings for several days, after which the experiment was closed.

The longest period during which any one specimen was under observation was eleven months. As a table of results would be confusing the results have been recorded by preparing curves demonstrating the absorption and re-evaporation of the moisture during stated intervals. Before discussing the results it is necessary

to state that the timber of all the specimens was thoroughly air-dry before being immersed in the water.

Probably the most striking point brought out by these experiments is the relatively small and slow absorption of water by Silver fir and Spruce as against the rapid and large absorption by *Terminalia tomentosa*. This fact may at first sight appear impossible, though it is fully verified by previous experiments when treating these three timbers in creosote oils and is no doubt accounted for by the presence of the moderate-sized to large pores which occur in *Terminalia tomentosa* as against the compact though soft fibre of the two conifers.

Shorea robusta behaved as might be expected, it took up little water, soon reached its maximum absorption and equally soon returned to its normal condition.

Tectona grandis, Pinus longifolia and *Pinus excelsa* might be grouped as one as far as their behaviour is concerned, they took up moisture fairly quickly at first, afterwards very steadily, while the maximum amount absorbed was by no means excessive. All three species responded quickly when taken out of the water and soon regained their normal condition.

Cedrela Toona took up a surprising amount of moisture during the first few days, took up more than either teak, Kail or Chir and never again regained its original weight.

The last point of interest is that both the *Terminalia tomentosa* and *Cedrela Toona* specimens showed increased weight as the moisture in the air increased in June and July, *i.e.*, once the monsoon rain set in.

The conclusions arrived at are that all these species show quick recovery when taken out of the water, indicating the possibility of seasoning the timber first in water and afterwards on land in shady places. As regards the possibility of treating these timbers with antiseptic oils or salts the results point to difficulty in treating Spruce and Silver fir, a circumstance which is much to be regretted, while the two pines, *Terminala tomentosa* and *Cedrela Toona* all absorb water readily and therefore could be treated without difficulty.

The point which requires further investigation is with regards to Spruce and Silver fir which are said to be bad floating timbers, as they become water-logged, certainly the specimens under observation show no signs of doing so, on the contrary they show a strong tendency to resist the entrance of water. It has been suggested that seasoned Spruce may not water-log whereas the reverse may be the case when immersed in a green state, a point which requires verification. Moreover, a circular section of Spruce which has been in a tank with running water for over 3 years and has been kept by the writer under observation, has up to date shown no tendency to sink. If any officer who has had experience in floating these species could throw any light on the subject, it would be of considerable value to all concerned.

NOTES FROM OLD MADRAS FOREST REPORTS.

(*Contributed.*)

The oldest annual report of the Madras forests on which we have been able to lay hands is that for the year 1873-74. In that year Col. Beddome was the head of the Department and his title was "Inspector of Forests." The whole Presidency appears to have been divided into 23 Forest Ranges, and the system of working was primitive, for the Board of Revenue reported that in several cases the same tract was worked as regards some trees by departmental agency, and as regards other trees by the license and voucher system.

A reference to "the high prices realised by Atcha logs felled on the banks of the Cauvery" possibly explains the absence of any marketable Atcha (*Hardwickia binata*) trees in the forests bordering the Cauvery at the present time.

A great deal of attention appears to have been paid to fuel plantations intended principally for the supply of railway fuel, and the change of policy which has developed is well evidenced by the fact that many of these fuel reserves, formed at great

expense some 40 years ago, are now to be handed over to village panchayats as village forests. The total revenue for the year was Rs. 4,49,541 and expenditure Rs. 3,53,184, or roughly about one-tenth of the figures for 1912-13.

The grazing fees which nowadays run into lakhs realised only the modest sum of Rs. 38. This was doubtless due to the idea which prevailed up to 1882 that a forest reserve was an area absolutely closed against man and beast, an idea which was responsible for much delay in the formation of reserves, as no reserve was allowed to include a public path. It is therefore not surprising to find that in the Kurnool Nallamalais, a block of 2,000 sq. miles of forest, only 300 sq. miles were reserved, and with the permit system in force and a numerically weak and illiterate subordinate staff the District Forest Officer reported that "half the revenue Government ought to get is lost."

Regarding South Arcot the Board reported that "the practice of letting headloads go free has had the effect the Board feared; seven bandy loads a day are taken into Trincomalai in this way. The amount for the whole district is said to be 20,000 tons." This is specially interesting in view of the fact that in recent years Government have exempted headloads of fuel from the operation of the transit rules.

From Tinnevelly it was reported that "the village jungles are controlled by Tahsildars and watched by village watchmen. The Deputy Conservator thinks the system is a failure and has a bad opinion of the watchmen; but the Collector is satisfied, and so all the people." Of course the Collector and the people were satisfied; the one received no complaints, the other destroyed the forests without interference; ten years later, Sir Mountstuart Grant Duff, then Governor of Madras, defined the position in a nutshell; he said, "The difference between the Collector and the Forest Officer is that the one wants the ryot to be happy to-day, and the other thinks of to-morrow." In view of the results of village forest management in the past, we shall watch with much interest the results of the new system which is now being introduced in accordance with the recommendations of the Forest Committee.

The Cauvery river above Erode was used as a means of transport and 1,280 tons of fuel were taken down to the railway in boats; at the present day the only boats on the river are "coracles," circular saucer-shaped bamboo frames covered with hides, and the cost of boating fuel down the river is enormous.

The only trained Forest Officer mentioned in the report is Mr. Peet, then a recently joined Assistant; the title of Conservator of Forests belonged to Collectors, to whom the Deputy Conservators submitted their annual reports, and the Collectors reported to the Board of Revenue. They were also expected to inspect the forests and issue orders on all forest matters, while no forest offenders could be prosecuted without their sanction.

In 1874-75 Captain Walker (late Col. Campbell Walker) was the "Inspector of Forests"; the area of the forests in the Presidency was not known, and the question of surveying them was opened.

The idea of closed reserves still flourished, and it appears to have been the practice to fence all reserves; from Cuddapah it was reported that "the new and some of the old reserves had to be fenced and the expenditure incurred was on the whole heavy, being Rs. 14,110 against Rs. 444 spent in 1873-74. No details of the nature of the fences are given, but remains of stone-walls still exist round some of the old reserves, and these are presumably the fences referred to. In more recent years (*e.g.*, in the famine of 1891) some newer reserves were enclosed with stone-walls as famine relief works, and already some doubts exist as to which reserves were fenced in the seventies, and which in the nineties.

The value (?) of statistics in these old reports is exemplified by the Board's remark regarding the Cuddapah plantations: "The number of trees given in the statement exactly corresponds with that given in the last year's return, and the Collector is requested to report how this has come to be, while a number of trees are reported to have been destroyed."

The revenue fell to Rs. 3,64,326, while expenditure increased to Rs. 3,97,872, but the Board pointed out that much of the expenditure was incurred on plantations which had not commenced

to give any returns, and excluding such expenditure the results of working showed a profit of Rs. 70,535. It is to be regretted that this system of separating capital from current expenditure is no longer in vogue.

The Board's remark that "The health of the department was not worse than usual" speaks for itself; to the present day I.F.S. occasionally stands for Infernally Feverish Service, in spite of the opening out of the forests by roads, and the erection of permanent camps, but in the olden days nearly all the forest camps were regular fever traps.

The amount of protection afforded to the forests may be judged by the condition of affairs in Ganjam when the Collector reported that 600 sq. miles were reserved, that much inconvenience was caused by the absence of any properly defined or demarcated boundary, that the forests were worked both departmentally and under the license and voucher system, and were under the control of one Forest Overseer and nine peons! We agree with his remark that "the arrangement appears to be of too general a character."

In 1875-76 though "Inspector of Forests" became again the "Conservator" which title was taken away from Collectors who were no longer held directly responsible for the working of the forests in their districts; since then the pendulum has swung back again, and Collectors are at present responsible (on paper) for the working of the forests in their districts. In this year a Forest Act Committee met, and a Forest Act was drafted; its fate is not recorded, but seven years passed before the Madras Forest Act came into being.

In this year the Napier Foundry Company was granted a lease of 412 sq. miles of forest near Mamandon in North Arcot for the manufacture of charcoal; the company was to make 3,600 tons of charcoal within two years. Apparently this lease was a short-lived one, for a few years later the Mamandon forests were being worked entirely for the supply of railway fuel.

A reference is made to the Nerinjapet raft channel, evidently an old means of transport which has long been lost sight of, and a proposal is made to reserve the forests to a length of 10 miles and

a width of six miles on both sides of the Cauvery from Nerinjapet to Cauverypuram for the supply of railway fuel ; this proposal was never carried out and much of the area is now under cultivation and will be under water when the new Cauvery dam is built.

The general condition of forest control is shown by the Conservator's statement that "as the rights to timber, etc., of Government, Zamindars, or other private owners, and ryots have not been settled in this Presidency, systematic conservancy has been almost impossible, and operations have been more or less of a desultory nature since the commencement."

There is an old story dating from the early days of the employment of trained officers which is not contained in any of the annual reports, but which is worth recording. The untrained Deputy Conservator was originally a gardener at home, and had been many years in the Forest Department ; shortly after the arrival of his new trained Assistant, a man in the local club remarked : "I say, what is this new Assistant of yours like ? I hear that he is a bit of a taxidermist."

"Taxidermist, be d—d," was the reply, "he's just as white as you and I."

CORRESPONDENCE

EXTRACTS.

ANIMALS THAT NEVER DRINK.

It would seem that water is so indispensable to life that no animals could exist without drinking. Nevertheless, Dr. Blanford asserts that the antelopes which live in the sand desert between the salt lake Chilka and the sea never drink. This has been doubted by physiologists, who deny that existence is possible in such conditions, but confirmatory evidence is now adduced by Dr. Drake-Brockman. It appears that since 1910 a troupe of gazelles have lived in the small island Saad-ud-din on the side of Somaliland where there is no source of water and where the annual rainfall is less than three inches, so that these gazelles cannot obtain water except after very rare showers. The vegetation is very poor and they cannot supplement the lack of water during the dry season by consuming roots and bulbous plants rich in liquid.—[*Scientific American.*]

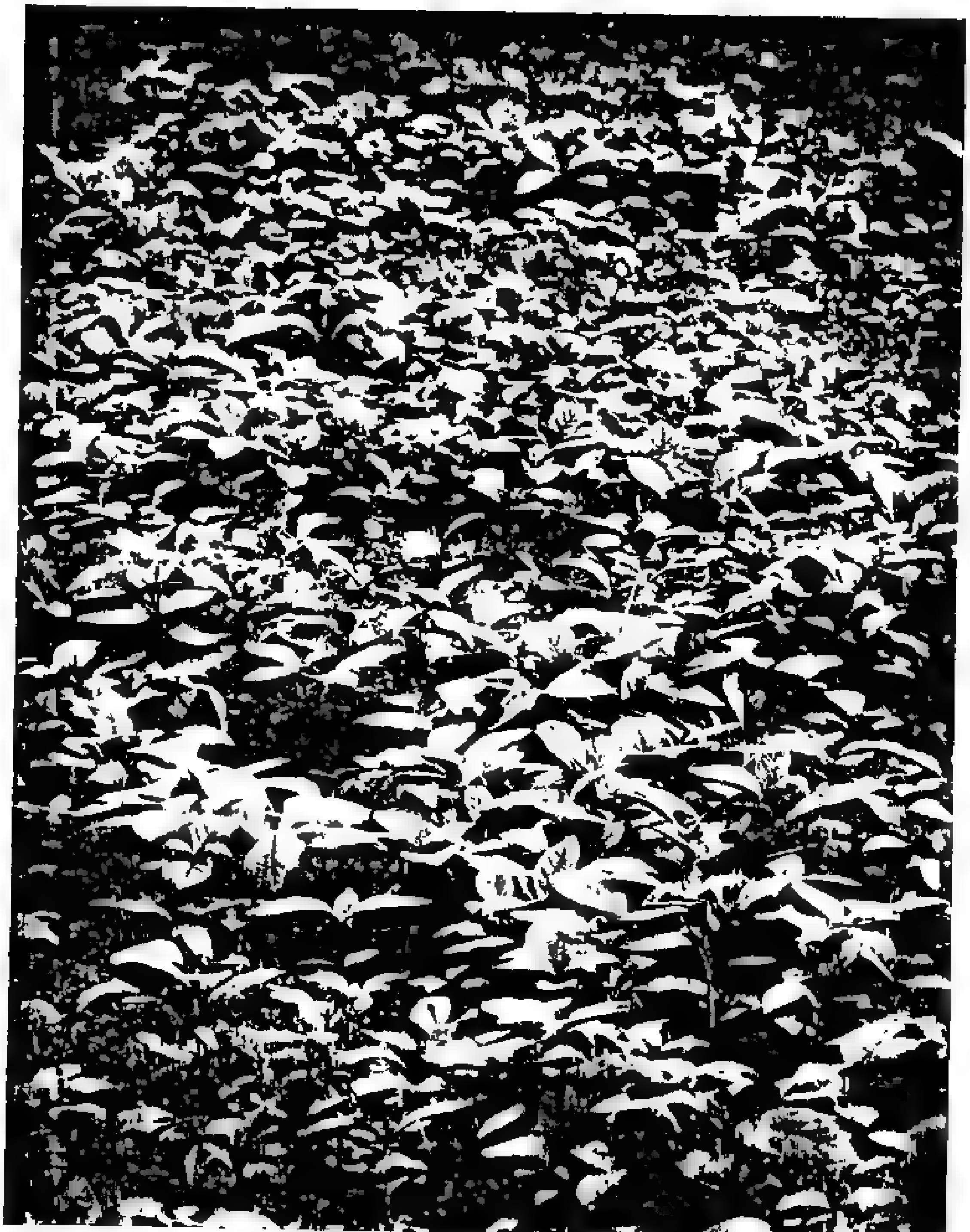


Photo. Mechl. Dept., Thomason College, Roorkee.

Germination of teak seed, over 2 years old, on a seed-bed in Godhra Nursery.

WATER-PROOFING QUALITIES OF SHELLAC.

The members of the Staff of Mount Rose Observatory, Nevada, have found shellac to be an impervious and pliable water-proofing for rubbers, which otherwise during a day's use on the snow-fields absorb sufficient moisture from the snow to dampen the feet. An application of the shellac at infrequent intervals kept the rubbers in perfect condition. It was also found that a coating of shellac on the thongs of snowshoes prevented them from becoming quickly water-soaked on wet snow, and so eliminated much of the sagging and heaviness that form a serious drawback to walking on webbed snowshoes over melting snow. Thongs coated with shellac also dried after becoming wet much more quickly than thongs uncoated.—[*Scientific American.*]

AN ORCHID WITH EXPLOSIVE FLOWERS.

Dr. H. N. Ridley ("Straits Settlements Gardens Bulletin," Vol. I, 1913, pp. 191—3) describes an orchid from Sarawak which shows a remarkable floral mechanism. This species (*Plocoglottis porphyrophylla*) is widely distributed in Malaya; but, being inconspicuous and a lover of deep shade, is but little known. It bears only one flower open at a time, but remains in flower for over three months producing a fresh flower every few days until the raceme is more than two feet long and has borne about fifty flowers. Unfortunately, the author's account is not accompanied by illustrations, but the following description may be followed if the reader examines any ordinary orchid flower. In the young flower the ovary begins to twist, as usual in orchids, until it has overtopped the bract; it carries the swelling bud through about 75 degrees and then stops twisting. During this twisting the dorsal sepal outgrows the other two sepals, and pushes over the apex of the bud. All the sepals at this stage are similarly narrowly ovate, the lateral ones asymmetrically so. The lateral petals are linear, and curved round the column to meet at their tips. The lip is about as broad as long, cuspidate above its broad shoulders, with the margins in the lower part frilled and turned under; if these margins are uncurved, it is seen that they are the lateral lobes of the lip. Under each broad shoulder a wart has begun to form.

Between this stage of the bud and maturity the following changes occur. The contiguous halves of the lateral sepals thicken from the middle upward; the cuspidate tip of the lip turns back, its shoulders enlarge, and the warts become sharp little upstanding cones while the side lobes increase along their margins so that they are too full for the space they have, and toward the base of the lip tend to form an upstanding rounded crest. Two very fleshy staminodes lie within the curve of this crest, one on each side. In opening, which occurs in late afternoon or early evening, a slit appears between the lateral sepals; then these sepals break away and slowly take up a position at right angles to the ovary, and their thickened areas become convex inward and throw the thin parts back; then the lateral petals rapidly elongate, curving over strongly, so that their points pass between the bases of the lateral sepals, and in this curious action they deflect the lip on to its base holding it down against a certain amount of resistance in contact with the lateral sepals. Thus the flower gapes somewhat. During the night the dorsal sepal turns back and the lateral petals straighten. The upper lateral sepal no longer held away from its fellows by the lateral petals now moves down to be in contact with it and is thus almost median as regards the lip, and as the lateral sepals move away the lip is caught against its convex swelling and held folded down as the lateral petals placed it. A touch now frees the lip and causes it to spring up against the column.

It is apparently fertilised by rather small insects, which, attracted to the flower, are trapped by the upspringing of the lip against the column, and, in struggling to free themselves, effect pollination. The mechanism is very curious; the lip is a trigger put into place by the lateral petals, and held there by one of the lateral sepals. This alone makes it of unusual interest, but this is heightened by the angle at which the flower stands, by the movement out of the median line of the column and by the movement toward it of a lateral sepal. The flower has apparently no scent and no free honey; its colors are lemon-yellow to yellowish-green, with deep crimson markings on the lip and the swollen parts of the lateral sepals are maroon.—*Knowledge*.—[*Scientific American*].

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NATURAL PRESERVATION OF MINE TIMBERS IN THE NORTHERN SHAN STATES.

BY D. P. HEWETT, I. F. S.

At Bawdwin, North Hsenwi, in the Northern Shan States, the Burma Mines Company are operating for silver and lead in an area formerly mined by the Chinese. The age of the Chinese workings is estimated to be from 200 to 500 years. In the Chinese workings mine timbers and bamboos have been found which show a remarkable state of preservation. Two specimens of these mine timbers, whose age was estimated from their situation to be about 250 years, were sent to the Forest Research Institute for identification and analysis, as it was thought that their excellent state of preservation was due to the highly mineralized nature of the mine water. The Research Institute reported that the lighter coloured specimen most resembled *Corylus ferox* (Wall.), but remarked that though this species occurs in the Eastern Himalayas there is no mention of its occurrence in the Northern Shan States. The dark specimen was reported to be most probably *Lagerstrœmia tomentosa*, discoloured by the action of the mineral water

in the mines. Neither of these timbers is at all durable. The result of the analysis was as follows: -

	Moisture.	Ash or total mineral matter	Water extract	Spirit extract
(1) Wood slightly dark in colour	11·31%	1·94%	0·84%	0·55%
(2) Wood of a lighter colour	11·38%	1·15%	0·78%	0·30%

On qualitative examination of both the ashes, they were found to consist of sulphate, iron, lime and alkali metals. Both the specimens were extracted in the form of filings with hydrochloric acid. The hydrochloric acid extracts of both the woods gave very faint reactions of arsenic, No. 2 slightly more pronounced than No. 1, showing the presence of merest traces. While extracting the woods with hydrochloric acid, hydrogen sulphide was evolved from both, No. 2 having more of sulphides than No. 1. Hence in hydrochloric acid extracts, iron, lime and sulphates were determined quantitatively.

	Calcium oxide.	Iron oxide	Sulphuric acid	Arsenic.	
No. 1	·06%	·12%	0·09%	Mere trace	
No. 2	·14%	·08%	0·21%	A trace	

(The percentage being calculated on the air dry wood.)

It would thus appear that the presence of iron and merest traces of arsenic have jointly served to preserve the woods under reference. The Research Institute then suggested that an examination should be made of the mine water in order to ascertain whether it contained any minerals or salts of a preservative character.

The following specimens of the mine water were accordingly sent:—No. 1 sample from the Main crosscut vertical shaft, 171 feet level; No. 2 sample from the workings from which the old

mine timbers were obtained; Nos. 3 and 4 samples from the bottom of the vertical shaft, 264 feet down. The first two samples were from the old workings and the other two from the bottom of the lowest new workings, not connected with the old workings. The samples were taken in the rains, so that it is probable that the strength of the mineral solution in the first two samples, which were from higher levels than the other two, was strongly diluted by surface infiltration. No. 1 sample bottle got broken in transit so that the analysis could only be carried out for the remaining three samples. The result of the analysis was as follows:—

The quantity of the sample No. 2 unfortunately was too small to admit of a detailed examination.

On qualitative examination it gave—

Chlorine, zinc, calcium, sodium, arsenic and a good deal of iron and sulphuric acid.

The samples Nos. 3 and 4 were mixed together. The resulting sample on qualitative tests showed

Calcium, sodium, carbonate, sulphate, iron, aluminium and arsenic.

It contained 7·89 grains per gallon of total mineral matter of which 2·84 grains per gallon were insoluble and 5·05 grains per gallon soluble. The arsenic found in this sample is 1·62 grains to a gallon. Iron and aluminium together 0·49 grains in one gallon

Though No. 2 showed qualitatively more arsenic than Nos. 3 and 4, yet both the solutions seem to be quite dilute.

The preservation of the timber was no doubt due to the presence of arsenic and iron oxide in the water. The old Chinese workings have been found to be full of water and the timber has thus been kept continually saturated. It is, no doubt, owing to this perpetual soaking that the timber has been preserved by so dilute a solution.

This note has been written at the request of the Forest Economist and has been extracted from my office file.

FLOWERING OF KYATHAUNG BAMBOO (*BAMBUSA POLYMORPHA*) IN THE PROME DIVISION, BURMA.

By J. W. Bradley, I.F.S.

Such is the nature of a Forest Officer's duty that he must sow, but only that others may reap. Seldom has he the gratification of seeing his labours come to fruition, and so a limitless patience, and an implicit confidence in nature and his successors to continue his work are essentials to his peace of mind. Even forest crops of the shortest rotation he is not likely to see both sown and reaped.

So with the *Kyathaung* bamboo, which is nothing more than a tree grass. Certainly no Forest Officer, and but very few native inhabitants, can lay claim to have witnessed the growth from seedling to maturity. So long are the intervals at which it flowers, and so rare is the occurrence of sporadic flowering, that there are at present very few in the service that can know the flower except by botanical description.

Brandis reports that the *Kyathaung* in the Pegu Yomas flowered in 1859 and 1860. Specimens were obtained in 1862 and again in 1871 and once since then flowering has been reported in Bassein.

It would seem, however, that 1859 and 1860 is the time when it flowered in its peculiar extensive and endemic manner. During the last 10 to 15 years it has been expected to do so again, and rumoured occurrence of flowering indications has led to the hurried convention of meetings to discuss how such an event should be met by Forest Officers. The regeneration of teak has been, and still is, thought by many to be intimately associated with the flowering and death of bamboos. And so with good reason it was thought that when the enormous areas covered by *Kyathaung* should flower and die, science ought to come in and assist nature, or rather, science should come in and assist teak when nature had, for a time at least, removed from the forest its bamboo canopy. Many schemes were rapidly evolved and most as rapidly abandoned. The one generally approved, namely, to cut down and burn the forests wholesale was eventually pronounced imprac-

ticable, for were the enormous amount of money forthcoming to carry it out, Burma with all her sons could not have supplied a fraction of the requisite labour. Finally it was decided to do nothing except on an experimental scale. Nature was to be left to settle her own big problems as she had always successfully settled them in the past.

2. Last year a Ranger in the Prome Division reported that he had seen a few flowering clumps of *Kyathaung* in the Byamain Reserve of the Shwele Range. It was thought, however, only a hearsay report, for he failed to substantiate it when asked for full details. This year in late January when touring with Mr. Leete, the Conservator of the Circle, another similar report reached us through the same Ranger, who was then with us. All incredulous we resolved to see what truth there was in the report, for to allow so important a tree as *Bambusa polymorpha* to flower and perish unseen would never do. We were not in time, however, to save some few clumps from so ignominious a fate, for we found that both reports were perfectly correct. The few odd clumps which had flowered last year were already dead and in an advanced stage of disintegration. And, moreover, beneath them—more particularly where light and moisture were more favourable—a dense carpet of seedlings varying in height from two or three to eighteen inches, had already restocked the vacant ground. The total area that had flowered last year would not aggregate more than about a quarter of an acre. This year the flowering has spread radially outwards, all the remaining clumps in last year's area flowering now, as well as all the *Kyathaung* in an area of about three square miles. But it is far from being the predominant bamboo in this area. *Myin* (D. strictus) and *Thaik* (B. Tulda) occupy far the major part, *Kyathaung* growing in the moister places close to streams and on northerly slopes. It occurs in small scattered areas amounting to something like 200 acres. The *Myin*, which in the Range generally is flowering over enormous areas, is, in this particular forest, rarely to be found flowering at all, whilst with *Thaik* only exceptionally is it not flowering.

The Byamain Reserve was notified as a Cutch Reserve in 1898 and it has been fire-protected since 1899. It lies some 12 miles N.-E of Padigon Railway station (Rangoon Prome line), so probably does not differ much in climate and rainfall in Prome itself. The Reserve is hilly, but the slopes are moderate and nowhere do they rise to a height of 500 feet.

In January the flowers were not fully opened, but by the middle of February, they were in full bloom. In general appearance the clumps are not unlike flowering clumps of *Thaik*, except that they have a distinctive and very pretty purple hue, the colour being due to the purple palea and anthers. The botanical description, however, can be found in Brandis.

3. One or two points of a non-botanical character may be worth recording.

Through the long years since *Kyathaung* flowered last, we have been told to expect that the year before flowering no new shoots will be put forth by the clump. This appears to be true for, from local enquiry, it seems that last year the local Burmans who are in the habit of using the new shoots to make the ubiquitous Burmese mat had to go several miles further away to get the new shoots which they require for their purpose. Whether, then, this failure to put forth new shoots extends further afield, and if it does extend, how far it will reach, is a thing that may be watched with considerable interest, for it would seem to be a fairly certain indication of flowering.

Again whilst last year flowering was merely sporadic, this year, throughout the affected areas, every clump, large and small, dominating and dominated has flowered. In this respect one isolated small clump near a village was of particular interest. All the large stems had been cut quite close to the ground. Also the clump bore traces of severe injury from fire. None the less the little clump had replaced its tall stems by a bushy growth of small canes not more than ten feet high, and in spite of the checks it has suffered from man and fire it was one mass of flowers in February. So, generally, fire does not seem either to retard or accelerate flowering, for though the Reserve is protected forest,

yet whenever this bamboo occurs in adjoining unprotected forest it is all flowering too.

So much for the *Kyathaung* which is flowering now. It remains to be seen whether it will extend over the enormous areas in the province as a whole where it now flourishes. Such an event certainly does not seem improbable, and since—in this district at least—other bamboos are flowering so extensively a serious shortage of bamboos would be a certain consequence.

The local Burmans are hoping that they may be allowed to cut taungyas to their heart's content in the flowered areas, and provided they leave their *yas* stocked with teak, it would seem well worth while to let them. But as to the possibility of a bamboo famine, the easy going Burman does not bother himself with any such woeful anticipations. He looks at the majestic flowering culms and says appreciatively "Te hla de" "It's very beautiful", and so it is, but we expected something more of him, to whom the bamboo means so much. Yet so the Burman goes through life, highly appreciating its beauties, leisurely enjoying its joys, and meekly enduring its tribulations. And who shall say his is not a sound philosophy!

REINFORCED CONCRETE BOUNDARY PILLARS FOR FOREST RESERVES.

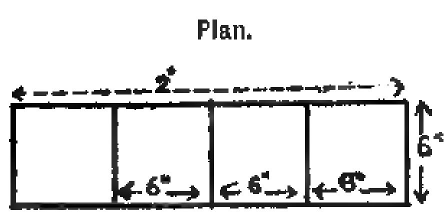
By A. J. Butterwick, Extra Assistant Conservator of Forests.

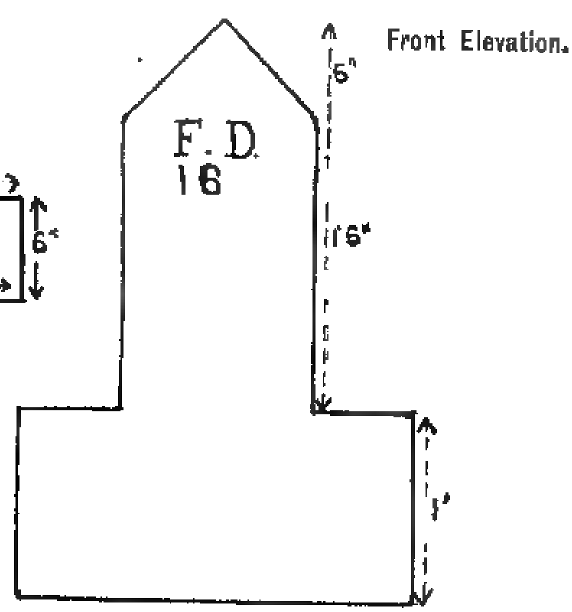
In Burma the usual kind of boundary pillar used to demarcate forest reserves is a post about 9 in length and 6" or 1' in diameter made of the most durable timber obtainable in the neighbourhood. This post is generally buried about 3′ in the ground and has a cairn of stones or a mound of earth about 3′ in height surrounding its base, thus leaving a top 3′ in length exposed. If the soil is sandy and lacks cohesion a gabion of bamboo-work or cane-work about 6′ in diameter is placed around the mound to keep it in position. The top of the pillar is sharpened to a point or edge so as to allow water to drain off easily, and at about a foot from the apex

are affixed small zinc figures showing the number of the pillar. This kind of pillar is cheap, easy to make and serves the purposes of the Forest Department most admirably. There are, however, certain places in which the use of such pillars is impracticable and the elephant fodder reserves in the Pyinmana Forest Division are some of these.

2. In these reserves, owing to fire, theft, elephants, the poor class of timber available, and the danger of the posts being moved by villagers it was not found practicable to use the ordinary type and it was decided by the Divisional Forest Officer to erect reinforced concrete boundary pillars instead. The work of making these was carried out by the students of the Burma Forest School, and with a hope that the experience gained therein may prove of some assistance to Forest Officers who may have to demarcate reserves similar to these, this account is submitted.

3. The form and dimensions of the boundary pillar decided upon are as shown in the drawings (scale 1" = 1' ft.) given below :—

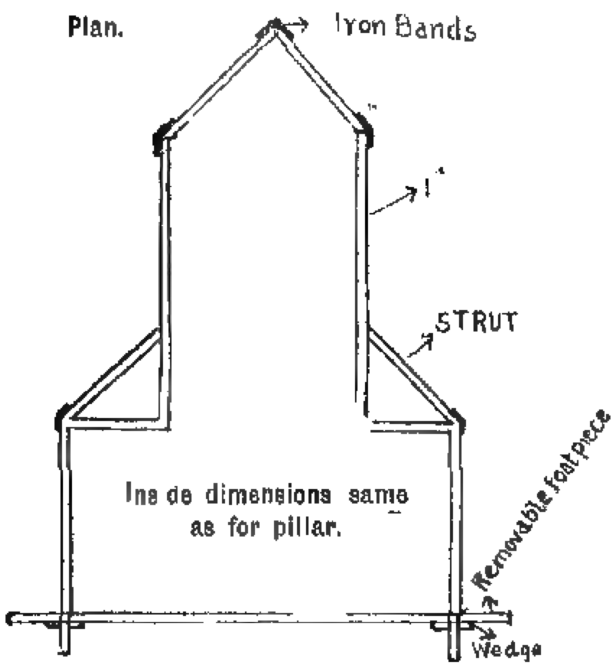


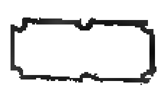


The volume of each pillar is 1·875 cubic feet At first a thickness of 1′ was tried but the pillars were found to be very heavy, cumbersome, and expensive, and it was decided to have them 6″ thick instead. The pillar was to be buried 1′ in the ground leaving 2′ exposed, which height was considered inconspicuous enough to escape the vigilant eye of the elephant.

4. For the manufacture of these pillars the following plant was requisitioned :—

(*a*) 15 moulds These were made of "thitya" (*Shorea obtusa*) wood according to the drawing shown below. Any timber, however, which does not warp very much in seasoning can be used for the purpose. These moulds had no bottoms to them and when the pillars were to be made, each (mould) was laid flat on a wooden platform 4′ × 4′ which had a pair of handles at either end so that the pillar, after the mould had been slid away, could be easily shifted about.



(*b*) Twenty wooden  blocks shaped thus for the construction of the metal skeleton frames. These blocks measured 9″ × 4″ × 1″ and

the grooves shown in the drawing had a diameter of $\frac{1}{8}''$.

(*c*) Wooden dies of the letters F. D. and the numbers. Each letter or number was 2" high and each die had a handle 4" long and was shaped like this :—

(letter or figure.)

(*d*) A wooden platform 12' × 6' for mixing the concrete.

(*e*) Buckets, baskets, hoes, trowels, stone-breaking hammers and wire-nippers.

(*f*) A wooden box 1' × 1' × 1' for measuring the constituents of the concrete.

5. *Site.*—In selecting the site for the work the following requirements had to be taken into consideration :—

(*a*) Site to be accessible to carts or boats and centrally situated so that the ready-made pillars could be easily transported for erection.

(*b*) Site to be on high ground and perfectly dry to ensure the cement remaining good.

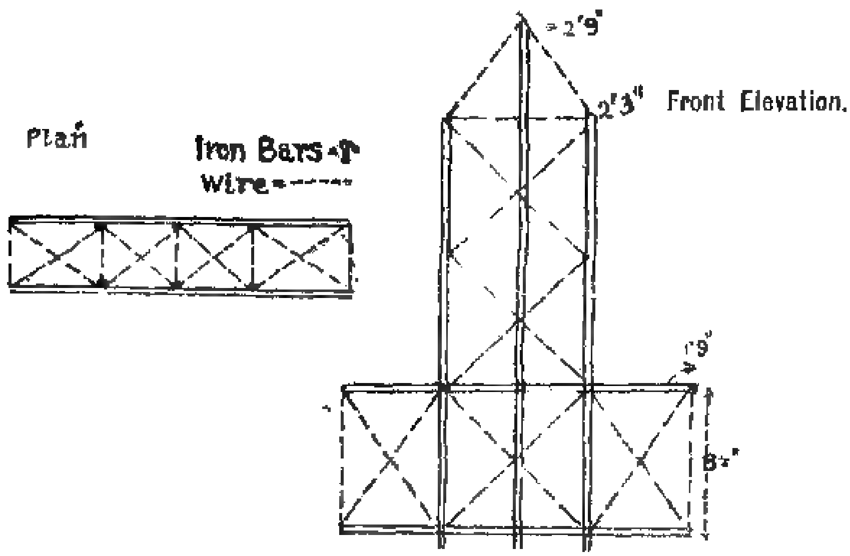
(*c*) Site to be near a comparatively large and shallow pool of water for the complete immersion of the pillars.

(*d*) To allow of the safe carriage of the imperfectly-set pillars to the above pool, site should have a gently sloping road leading from it to the pool.

A suitable site answering to the above requirements was easily found near the banks of the Sittang river and with a little digging a very efficient inlet was made free from the current and sufficiently large and shallow for the safe immersion of the pillars. This site chosen was about 2 miles east of the Yeni Railway station which is by rail about 206 miles north of Rangoon

6. *Metal Skeleton Frames.*—For the reinforcement of the concrete, metal skeleton frames were required and these were made

on the wooden blocks mentioned in para. 4 (*b*) above, the iron bars mentioned below being fitted into the grooves. A drawing of the finished frame (scale 1" = 1 ft.) is given below:—



The following materials were required for the construction of each frame:—

(*a*) 10 cast-iron bars, two 2' 9" long, four 2' 3" long, and four 1' 9" long.

(*b*) 22 yards of very thin flexible galvanised wire to bind the above bars together.

At first iron bars $\frac{1}{2}''$ in diameter were used, but these were found to be too heavy and expensive and $\frac{1}{4}''$ ones were substituted and did very well. Galvanised wire measuring No. 4 gauge or thereabouts would, I think, be a very satisfactory substitute for the iron bars. The thin flexible galvanised wire mentioned above was obtained from ordinary galvanised strand fencing wire and answered our purposes very well. One man could make 5 such frames in one day.

7 *Concrete.*—The concrete consisted of 5 parts broken stone aggregate, 2 parts sand, 1 part cement.

(*a*) *Broken stone aggregate.*—At first large stones were brought in from the bed of a stream about 4 miles off and were broken into chips by hired labour. These chips had to be angular and had not to exceed ½″ gauge. These stones were, however, found to be so large and hard, being granite, that even after they were baked for 24 hours, one man could not finish breaking more than 1½ cubic feet in one day. It was afterwards found much more economical and as satisfactory to obtain pebbles dug out from pits dug in an Indaing forest close by as these were smaller and slightly softer. It was then found that a cooly could break without much difficulty about 2½ cubic feet in a day. Just before use these small ½ gauge broken stones were placed in baskets and thoroughly washed in the river, so that the surfaces might be clean and the edges sharp.

(*b*) *Sand.*—The sand was obtained from the bed of a dry stream in the vicinity and answered the purpose admirably as it was clean and fairly coarse-grained.

(*c*) *Cement.*—The best Portland cement obtainable in Rangoon was purchased and including railway freight, cartage, etc., the cost of each cask of 4 cubic feet came to Rs. 10-10-0.

8. *Preparation of the Moulds.*—Before the mixing of the concrete was started, each mould was thoroughly cleaned, placed on a platform as described above and made as level as possible. All the joints were then carefully caulked with clay to prevent the water with the finer particles of the cement in suspension from oozing out. The whole of the inside was then thinly smeared with ordinary earth-oil. This was done not only to prevent the sides of the pillar from sticking to the mould but also to give these sides a smooth appearance.

9. *Mixing of the Concrete*—Concrete sufficient for 5 pillars was mixed at one time and the following materials were used for the same:—

10 cubic feet broken stone, 4 cubic feet sand, 2 cubic feet cement. It may sound strange that 16 cubic feet of materials were required in addition to the skeleton frames and water to make 5 pillars, the total volume of which just exceeded 9 cubic feet, but it

must be remembered that the cement and sand with the water just helped to fill the spaces between the chips of stone, and spaces themselves were reduced in volume by ramming. The 10 cubic feet of stone after being washed was spread evenly on the mixing platform, the 4 cubic feet of sand was then spread over the stone and the 2 cubic feet of cement over the sand. The whole was then mixed dry, gradually and thoroughly, by 4 men working with hoes. After the materials had been thoroughly mixed together, the mixture was then heaped up on one-half of the platform. A small amount of it was then extracted on to the unoccupied half and sufficient water was then added to it to bring it, when mixed, to a pasty state. This was then used up and a fresh supply was mixed with water and so on. It was found that by thus mixing small quantities better concrete was made as the cement had no time to set on the platform after the water had been added

10. *Filling in the Moulds.* The wet mixture was then transferred by means of buckets into the prepared moulds. After a layer about 1" thick had been spread in the mould the skeleton frame was fitted in and shaken into position; the concrete was then poured in as quickly as possible and rammed down by means of iron bars and trowels. Each mould was thus completely filled, the surface being then properly smoothened by means of a trowel. To get a clear impression of the letters F. D. and the number of the pillar it was found necessary to spread a ¼" layer of plaster consisting of 2 parts sand and 1 part of cement near the apex of the pillar. When this had partially dried the letters and numbers, which had previously been earth-oiled, were impressed on it.

11. *Setting of the Concrete in the Pillar.*—Nothing else then remained to be done to the pillars but to allow them to set. At first a grass covering, which was kept constantly damp, was placed over each of them. After 24 hours this covering was taken off, and the mould was removed by taking off the foot-piece and gently hammering the ends until the whole slid off without injury to the pillar. The pillar was then covered with wet sand for another 12 hours after which it was removed on the platforms

for immersion and allowed to slide gently into the water. Each pillar was kept entirely immersed in the water for 10 days, after which it was taken out and found to be thoroughly set. The impressions of the letters and numbers were then scraped out and painted over with coal-tar. The pillar was then ready to be erected. Each one was found to weigh at its completion 77¾ viss or about 271 lbs. and one bullock cart in one trip carried with ease three.

12. *Cost.*—As mentioned above except for the breaking of the stones which was done by daily labour, all the other work was carried out by the students of the Burma Forest School. The cost therefore given below is not the actual one and has been based on observations made during the progress of the work.

The broken stone aggregate cost Rs. 12 per hundred cubic feet for carting and 4 annas a cubic foot for breaking. The cost of 2 cubic feet of aggregate, which is required for one pillar, thus comes to about Re. 0-12-0. Sand was obtained free and as mentioned before one cask of cement, which did for 10 pillars, cost Rs. 10-10-0 delivered at site. The value of cement in each pillar accordingly comes to Re. 1-1-0. Iron bars ¼" in diameter, cut into the required sizes, sufficient for 50 pillars, cost at Pyinmana Rs. 15, which gives a cost per pillar of about Re 0-5-0. It was also calculated that the value of galvanised wire used did not amount to more than Re. 0-2-0 per pillar, whilst the cost of earth-oil and coal-tar per same unit did not exceed Re. 0-0-6.

Labour will cost approximately as follows :—

One man on Re. 0-8-0 per day can make 5 skeleton frames, and six men on the same daily pay, it was calculated, could make up easily in one day 12 pillars. The cost of labour per pillar will therefore be not more than Re. 0-6-0.

From the above data the total cost of one pillar should be—

	Rs.	a.	p.
Broken stone	0	12	0
Cement	1	1	0
Iron bars	0	5	0

				Rs.	a.	p.
Galvanised wire	...	...	...	0	2	0
Earth-oil and tar	...	...	...	0	0	6
Labour	...	...	...	0	6	0
		Total	...	2	10	6

This cost is capable of being reduced as I have taken the maximum rates for each item. The price of the plant has not been considered as the same moulds, platforms, etc., can be used over and over again for as many pillars as may be required.

The cost of carriage to the site for erection and the cost of the erection itself will vary greatly in different parts of the country but where good roads exist the total cost of both should not exceed Re. 0-4 0 a pillar.

13 *Advantages.*—Before enumerating the advantages of reinforced concrete boundary pillars, it must first be confessed that in places where cart-roads do not exist or are exceedingly few, these pillars cannot be used for demarcating forest reserves, for the cost of transport to the site would be prohibitive. But in places where cart traffic is the principal means of transport, the advantages of this kind of pillars over the ordinary wooden ones are manifold. Besides being rot-proof and insect proof, a reinforced concrete pillar will stand very great heat without any damage. To the villager, except as a monument on which to write his epitaph, it is of no use. It is too heavy to be easily shifted by the land snatching agriculturist and it will stand rough usage. Further its height does not attract the eye of the elephant. It is therefore practically everlasting and any extra cost which its manufacture entails is therefore in my humble opinion amply justified, when conditions similar to those described in this note prevail.

A NOTE ON SALTWORTS OF SOUTH ARCOT.

BY T. P. GHOSE, B.Sc.

An interesting case dealing with the composition of the ash of saltworts from South Arcot has just been dealt with by the Chemical Adviser, the main facts of which are recorded in this note for general information.

Under instructions from the Conservator of Forests, Southern Circle, Trichinopoly, the District Forest Officer, South Arcot, sent samples of two varieties (A and B), of saltworts locally known as "Umari" or sometimes "Umari Nandi," with a request that the plants be examined and suggestions made for some improved method of extracting the "barilla" from them. It was also mentioned that the enquiry would be of great economic value. A sample of locally made "barilla" was also received for analysis.

The following description of the plants and the local method of manufacturing the "barilla" has been taken from the note kindly supplied by the same officer.

There are two distinct varieties of the plant locally known as "Umari Nandi" in South Arcot District. Variety (A) sometimes grows to a height of 6′ whereas the variety (B) never grows to more than 2′ in height. The latter is sometimes known as "Paglapasi." The botanical name of A as identified by the Forest Botanist is *Suæda monoica*, Forsk. These plants occur as gregarious weed forming the undergrowth in the mangrove forests of the district. They also flourish in saline soils subject to tidal influence. The "barilla" extracted from them finds a ready market, being largely employed in connection with dyeing cloth.

The right to cut and collect and extract the alkali is annually sold by auction. The cutting is generally carried on during the dry weather when the ground is dry. The plants are dried in the sun for two or three days; care being taken not to overdo this. They are then burnt in round pits 3 to 4′ in diameter and 2′ to 3′ in depth. As the stuff burns more and more of it is continually added to the burning mass which is always kept stirred. The fused alkali now comes out as a liquid and collects at the bottom of the pit in a separate mass which on cooling forms the "barilla" ready for export.

The above method of extracting "barilla" is practically the same as practised in other parts of the country. In the Punjab the process differs in that one or more inverted vessels with their bottoms perforated are placed inside the pit (see "Punjab Products," Vol. 86 of 1868). The purer alkali is said to collect inside these vessels and the impure part mixed with ashes and earthy matter at the bottom of the pit. The best known saltwort of Punjab is *Caroxylon Griffithii* ("Khagan khar"). Besides this *Salsola indica* ("lana") and *Salsola Kali* are also used. *Suæda nudiflora* ("lani" of Sindh) is the chief saltwort both of Sindh and Aden (Dic Eco. Pro., B. 163).

In Spon's Encyclopædia of Manufactures and Raw Materials (page 280) the "barilla" from *Salsola soda* is stated to contain 40·95 per cent. and *Salsola carvifolia* 45·99 per cent. and *Salsola Kali* 34·00 per cent. of sodium carbonate.

Nothing definite has been recorded about the composition of Indian "barilla" excepting that it is a mixture of soda carbonate, sulphate and chloride in varying proportions.

The "barilla" from South Arcot on being analysed was found to contain—

Soluble salts	80·36 %
Insoluble matter	17·81 %
Moisture	1·83 %

The soluble salts consisted of—

Sodium chloride	88·30 %
" carbonate	6·47 %
" sulphate	3·53 %
" sulphide	1·70 %

The percentage of soda carbonate calculated in total "barilla" is only 5·2 per cent. whereas sodium chloride is 70·99 per cent. The Punjab "barilla" ("lota sajji khar") is reported to be very rich in carbonates, hence for the sake of comparison a bazar sample of the same was analysed and found to contain—

Soluble salts	63·92 %
Insoluble matter	23·31 %
Moisture	12·77 %

The soluble ash consisted of—

Sodium chloride	... ...	6·32 %
„ carbonate	... ..	83·06 %
„ sulphide	... ...	4·84 %
„ sulphate and other salts	...	5·78 %

Hence the percentage of sodium carbonate present in the "barilla" is 53·1 per cent. Sodium chloride occurs only as an impurity. From the above results it is apparent that the South Arcot sample is very inferior in quality. The other variety is much richer in carbonate and in fact compares favourably with the black ash of commerce which generally contains from 37·90 per cent. to 44 per cent. of sodium carbonate.

The manufacture of "barilla" has been practised in this country from ancient times. In fact before the invention of Leblanc's process for alkali manufacture, the above industry had also flourished in Spain, France and other European countries. It is hopeless to think seriously of manufacturing "barilla" in this country on any large scale in competition with the modern methods of manufacture and distribution.

It is however curious that alkalis, consisting either of impure soda carbonate mixed with salt as in the case of Punjab sajji or mostly of common salt mixed with a little soda carbonate sulphate like South Arcot "barilla" should still find a ready local market, considering that pure soda ash can be had at almost the same price as "barilla," making allowance, of course, for the actual soda content of the latter.

The manufacture of "barilla" in different localities of India can therefore be regarded as the last remnant of an ancient industry kept up by the general ignorance and prejudice of the people. As early as 1888, the Madras Government had also arrived at the conclusion that it was doubtful whether it would pay to manufacture alkali either from "reh" efflorescence or from salt-worts in competition with the imported carbonate (Agri. Ledger No. 5 of 1902, page 129).

No effort is therefore called for to improve the existing method of making "barilla" which will die its natural death in the

near future as the industrial conditions and the knowledge of the people develop.

The interesting point incidentally brought out by the analysis of the plants is that the composition of the ashes obtained by the incineration of the plants is practically the same as that of the ashes obtained by evaporating and igniting the aqueous extracts of the same.

The varieties A and B were powdered and all aqueous matter extracted. The aqueous extract thus obtained was evaporated and incinerated. A gave 6·64 per cent. of soluble, 3·12 per cent. of insoluble ashes. B gave 27·31 per cent. of soluble, 2·64 per cent. of insoluble ashes.

The soluble ashes were composed of—

			A	B
Sodium chloride	...	...	86·16 %	96·46 %
" sulphate	..	...	2·64 %	0·29 %
Calcium "	...	.	5·84 %	1·07 %
Magnesium "	...	...	5·36 %	2·18 %
			100·00	100·00

The "barilla" contains 88·30 per cent. of sodium chloride. Hence it is evident that the ash of the plant consists only of the salts absorbed from the soil. The predominance of common salt in the above sample is due to the soil being subject to tidal influence. The Punjab "sajji" is rich in carbonate because the "rehal" or saline soils of Punjab are, as it is well known, charged with soda carbonate and sulphate with a little of chloride in them. The nature of the "barilla" thus depends on the nature of salts absorbed by the saltworts from different soils.

EXTRACTS.

PROMOTION OF RANGERS TO THE PROVINCIAL SERVICE AS PROBATIONERS.

The following has been sent us for publication :—

From—F. NOYCE, ESQ, I C.S, Under-Secretary to the Government of India,

To—The CHIEF SECRETARY to the Government of the United Provinces.

Simla, the 30th July 1914.

SIR,—In reply to your letter No. 94 L., dated 19th June 1914, I am directed to say that there is no objection to the Local Government imposing on Rangers whom it is proposed to promote to the Provincial Forest Service such period of probation as may be considered desirable.

2. I am to invite attention to the memorandum of this Department No. 31-F./290—2, dated 9th December 1911, with which was forwarded a copy of letter No. 1165-F./290—2 of the same date to the address of the Chief Commissioner, Central Provinces, in which it was stated that an officer promoted from the Subordinate Forest Service to the Provincial Forest Service shall count all periods, whether continuous or broken, of probationary service as Extra Assistant Conservator of Forests towards increments under the time scale of pay.

I have, etc.,
(Sd.) F. NOYCE,
Under-Secretary.

FORESTRY IN SCOTLAND.

The powers and duties of the Board continued throughout 1913 as defined under section 4 of the Small Landholders (Scotland) Act, 1911, with regard to promoting the interests of forestry, collecting and preparing statistics, making enquiries, experiments and research, and promoting, aiding and developing forestry instruction.

Forestry matters have, as in 1912, been in the charge of the Commissioner for Small Holdings; but the Board have continued to have the assistance of an Advisory Committee consisting of the members appointed in July 1912; and the services of Mr. John Nisbet, Advisory Officer in Forestry, have been available both to the Board and to the Advisory Committee.

ADVISORY COMMITTEE'S RECOMMENDATIONS.

Seven meetings of the Advisory Committee were held in 1913, for the consideration of matters remitted to them by the Board for advice; and the Board have endeavoured to carry into effect the recommendations made to them after resolutions had been adopted by the Committee.

The chief matters remitted to, and carefully considered and advised upon by this Committee have been as follows :—

1. *The acquisition of a Forest Demonstration Area in Scotland*, as recommended by the Departmental Committee in 1911 (and as already outlined on pages xxxiii and xxxiv of the Board's Report for 1912). After making careful and exhaustive investigations concerning a number of estates throughout Scotland, the particulars about which had been obtained either by public advertisement or by private enquiry, and after considering the reports furnished by the Board's Advisory Officer in Forestry, the Committee selected as the most suitable tract available to purchase an area of about 3,924 acres (of which 1,471 acres are already under well-grown timber), situated in the south of Aberdeenshire, close to Kincardineshire. The Board adopted the Advisory Committee's recommendation, and requested the Treasury to provide in the Estimates for 1914-15 for the purchase and equipment of this area. The

Committee's report recommending the acquisition of this area was sent to the Development Commissioners in December 1913, for their consideration as to whether they will approve the project and advise the Treasury to grant the necessary funds; but in the meantime the Development Commissioners have been making inquiries as to whether a suitable area, nearer to the geographical centre of Scotland, cannot be obtained upon long leasehold terms.

2. *The temporary appointment of five Forest Officers for three years*, to be employed in preparing working-plans for existing woodland and in general advisory work, for making a "flying survey" to ascertain roughly the amount of plantable land in the different counties of Scotland, and to begin forestry research work (as was outlined on pages xxxiv and xxxv of the Board's Report for 1912; but see also the remarks made on page lvi of this Report). In 1912 the Advisory Committee had recommended the Board to adopt a scheme drawn up by Mr. Nisbet, the Board's Advisory Officer, and to apply to the Development Commissioners for a grant from the Development Fund to cover the necessary expenditure. Acting on this recommendation, the Board sent in an application in March 1913, but the terms upon which the grant will be made have not yet been decided.

3. *Advances to Local Authorities for Planting.*—The Development Commissioners announced that they were prepared to recommend loans not exceeding £5 per acre planted (repayable with compound interest at 3 per cent. from the proceeds of the sale of the timber thus grown), subject to the conditions that the work should be carried out with expert advice, and that the plantations should always be open for inspection and available (if required) for the purposes of education, research and demonstration. Three applications for such grants were received. The Board approved, and the Commissioners recommended a loan of £150 (or of so much of it as may be required up to 31st March 1916) to the Edinburgh and District Water Trust for the experimental planting of about 32 acres of their Talla Water Catchment Area in Peeblesshire. This loan was accepted on these conditions.

4. *Afforestation and Development Trust.*—To meet the difficulty of finding a suitable body to be entrusted with loans from the Development Fund for approved schemes of forestry, Mr. Robt. Galloway, S.S.C., 19, Castle Street, Edinburgh, submitted, for the approval and sanction of the Development Commissioners, the prospectus of an Afforestation and Development Trust which it was proposed to promote. Subject to stipulations as to general control, the Board, on the advice of the Advisory Committee, approved the proposal and recommended it to the favourable consideration of the Development Commissioners, whose decision was still awaited at the end of 1913.*

5. *The Appointment of Forestry Correspondents* (as outlined on page xxxv of the Board's Report for 1912).—The Board had, on the recommendation of the Advisory Committee, requested the sanction of the Treasury to the employment of forestry correspondents, and a small expenditure was sanctioned, late in December 1913, for the purpose of a special and temporary investigation. A scheme has been prepared, and is now being given effect to.

6. *Matters concerning Forestry, Education and Research, and various miscellaneous subjects,* were also remitted to the Advisory Committee for consideration and advice, and the action taken thereon by the Board is summarised below.

FORESTRY, EDUCATION AND RESEARCH.

1. *Edinburgh.*—Difficulties having arisen in the relations between the Edinburgh University and the East of Scotland College of Agriculture with regard to various matters concerning the teaching of forestry, a Sub-Committee (of the Forestry Advisory Committee), consisting of Mr. Sutherland (chairman), Lord Lovat,

* Subsequently, on March 16th, 1914, the Development Commissioners informed the Board "*that they are now advised that the Development and Road Improvement Funds Act, 1909, will permit of advances being made to a public authority or body of persons not trading for profit for the afforestation of land leased from private owners,*" and further that they "*will communicate with the Board of Agriculture for Scotland in regard to the method of providing for the settlement and execution of any suitable schemes on their leases which may be put forward*"

and Sir John Stirling-Maxwell, was appointed to make enquiries as to the position regarding the grants made jointly to these bodies for forestry teaching, and to endeavour to secure a settlement of the points in dispute. This was followed by a meeting of a joint committee of the University and the College of Agriculture on 22nd May 1913, at which agreements were unanimously come to regarding a joint forestry curriculum.

2. *Glasgow.* An important piece of research work was carried out by Mr. G. P. Gordon, lecturer in forestry at the West of Scotland Agricultural College, concerning a serious windfall of timber which took place on the Buchanan estate, Stirlingshire, in 1912. The blown area extended to about 350 acres, and included woods from 40 to 85 years old occupying exposed positions. Even a rough examination showed that much of the damage could have been prevented had the woods been under scientific management. In a large Douglas Fir wood, 45 to 52 years old, the utility of a "severance cutting" as a protection against windfall was well shown, through a ride having formerly been cut accidentally at right angles to the direction of the most dangerous winds Although hundreds of trees had been blown down on the windward side, yet only two were thrown on the lee-side of this casual "severance." A stem-analysis was also made of Douglas Fir trees, 45 and 52 years old, in order to determine the rate of growth at different ages. It is hoped that a report on this inquiry will shortly be issued.

3. *Aberdeen.*—The University Court promulgated an ordinance for the institution of a degree of Science in Forestry, which, however, will not take effect until approved by His Majesty in Council after the statutory period during which it must lie before both Houses of Parliament has expired.

An application from the University for a grant from the Development Fund was referred from the Treasury to the Board for a report. The application was difficult to deal with, in consequence of there being no clear or well-defined distribution of the work concerning the teaching of forestry between the University and the North of Scotland Agricultural College. After the matter had

been carefully considered by the Forestry Advisory Committee, the Board, adopting the Committee's advice, recommended that applications for £2,000 for the equipment of a Forestry Museum and Laboratories and for a further sum not exceeding £7,500 for Forestry Class-rooms be approved; but an application for a grant to appoint an additional staff for forestry teaching could not at present be recommended, as it raised a question of policy.

FORESTRY STATISTICS.

The Board have not, as yet, been able to publish many statistics relative to forestry, but a return of the wood and timber imports into and exports from Scotland during 1913 was obtained from the Board of Customs and Excise, which is (with the consent of that Board) shown as Appendix No. 20, p 30.

This Appendix seems to be very well worthy of serious consideration. It not only shows that in addition to all the marketable wood obtainable from the existing 868,409 acres classifiable as woodlands in Scotland, 25,577 tons of furniture woods, hardwoods, etc., and 1,444,035 loads of other timber were needed in 1913 to satisfy the present current demands of our wood-consuming industries, and that only 7,547 loads in all were exported; but besides this, it also shows that, after deducting the 47,037 loads of teak and oak and the 25,577 tons of mahogany, unenumerated hardwoods and furniture woods imported mostly from tropical and sub-tropical countries—woods that in any case cannot be grown in the climate and on the soil usually found throughout the waste lands or poor pastures of Scotland—the imports consist almost entirely of coniferous wood and timber, for the growing of which upon commercial lines both the climate and the soil of Scotland are eminently suitable. To supply the demand for pitprops and pitwoods alone, 475,462 loads had to be imported, and to ensure the supply of home-grown wood to this amount one would need to plant about 5,000 acres annually from now onwards during each of the next 40 years; but even in that case it would be 40 years before Scotland could *continuously* satisfy its own demand for pitwood, and even then only if this annual demand were not to increase above what

it now is. Again, the 764,423 loads of hewn or split "fir" (*i.e.*, roughly converted timber) would also require the planting of about another 5,000 acres annually from now onwards for each of the next 80 years before Scotland could supply *continuously* the amount of coniferous timber now annually needed by its general wood-consuming industries (other than the special needs of the mining industry). In other words, to ensure a *continuous* supply of home-grown conifer wood and timber for Scotland alone, plantations amounting to 10,000 acres a year would have to be made during each of the next 40 years, and of other 5,000 acres a year for 40 years longer (*i.e.*, from 40 to 80 years from now), in order that from the 40th year onwards the present annual demand for pitwood could be supplied, and that from the 80th year onwards the present annual demand for conifer timber for other industries could similarly be satisfactorily met from the thinnings and the mature falls. There would thus, to meet only the present needs of Scotland, have to be—

(1) about 200,000 acres of conifer woods for the pitwood supply (from thinnings and final fall), worked with a rotation of 40 years (including a "fallow" period, if rendered necessary on account of the Pine Weevil or other destructive agent); and also

(2) about 400,000 acres of conifer timber forest for the supply (for thinnings and mature fall) of the other wood-consuming industries, worked with a rotation of 80 years (including a similar "fallow" period, if necessary).

Thus a total of 600,000 acres of new conifer woods is needed beyond what exist at present. Where such woods could best be planted throughout Scotland can only be suggested when once a "flying survey" has been completed county by county, as already proposed (see page liii.)—[*Report of the Board of Agriculture for Scotland.*]

THE VARIETIES OF SHELLAC.

The following description of the nature and the various kinds of shellac is given on the authority of a New York shellac company :—

T. N. Shellac.—The initials "T. N." are indicative of the quality or grade of orange, which comprises 60 per cent. of the shellac that is manufactured in the course of the year. These initials stand for "Truly Native." This quality is used thus extensively, because of low price and of the fact that this darker colour does not enter into important consideration.

Medium Grades of Orange.—The same quality of stick lac or of selected grades of bysackie is used, and the colour is lightened by the use of orpiment or, as it is more commonly known, arsenic.

High Grades of Fine Oranges are manufactured from the highest grade of stick lac, which is known as "Koosmie," and is gathered late in the fall from a tree known as the "Pallas Tree." This grade of goods is exceptionally clean, and contains practically little or no orpiment, and is used mostly by high-grade furniture manufacturers for silvering the backs of mirrors, also for pattern work, and for plastic or composition materials.

"*Garnet*" *Lac* is lac with the lac dye left in it, used mostly by hat manufacturers and shoe-blacking manufacturers, and is made either pure or 10 per cent. added rosin.

"*Button*" *Lac* is made the same as orange shellac with the exception that it contains more natural wax. It derives its name from its shape.

"*Tongue*" *Lac* is exactly the same as button lac, and derives its name from its shape.

Stick Lac is the crude material just as it is taken from the trees with the incrustation of lac and lac bugs, and contains all the animal and vegetable matters as well as the lac dye.

Seed Lac is the same as stick lac, except that it is ground and washed, the lac dye being partially removed, and, in some cases, entirely removed. It is used mostly by lacquer manufacturers.

Kala is an inferior garnet or "button" lac, and is made from the refuse of the other lacs. It contains a large percentage of added rosin.

Bleached Shellac is orange shellac that has been treated with a chlorine process. There are about six million pounds of this bleached shellac used in the United States in the course of a year. It is used on imitation ivory, backs of brushes and combs, tooth brushes, poker chips, and all white insulated goods. It is used very extensively dissolved in alcohol as a white varnish for a finishing coat on furniture of all kinds. There is a very superior quality known as refined bleached which is the result of a process whereby all the vegetable wax, together with the chlorine used in the bleaching process, have been entirely eliminated. This meets with a very large sale for making lacquers, French polishes, and high class finishing of hardwood.

Shellac.—Gum shellac is the hardest known gum that has ever been discovered or manufactured. Were it possible to dissolve gum shellac in either turpentine or linseed oil, the same as with what is known as varnish gum, it would be more durable than any other gum for outside work coming in contact with the atmospheric conditions; but inasmuch as it is only solvent in either methyl or ethyl alcohol, it is used most extensively for inside work. During the year 1912 some 225,000 packages (containing approximately 170 lbs. net each) were manufactured and shipped from the primary market, Calcutta. During the last twenty years, the increase in the exportation of shellac from Calcutta has been about 350 per cent., and the propagation and cultivation of lac trees have extended all over India Some twenty years ago there were only a few species of trees on which lac was produced. There are now very close on one hundred different species of trees, which fact shows how the lac-bearing area has been extended.—[*The Indian Trade Journal.*]

Forest Research Institute, Dehra Dun.

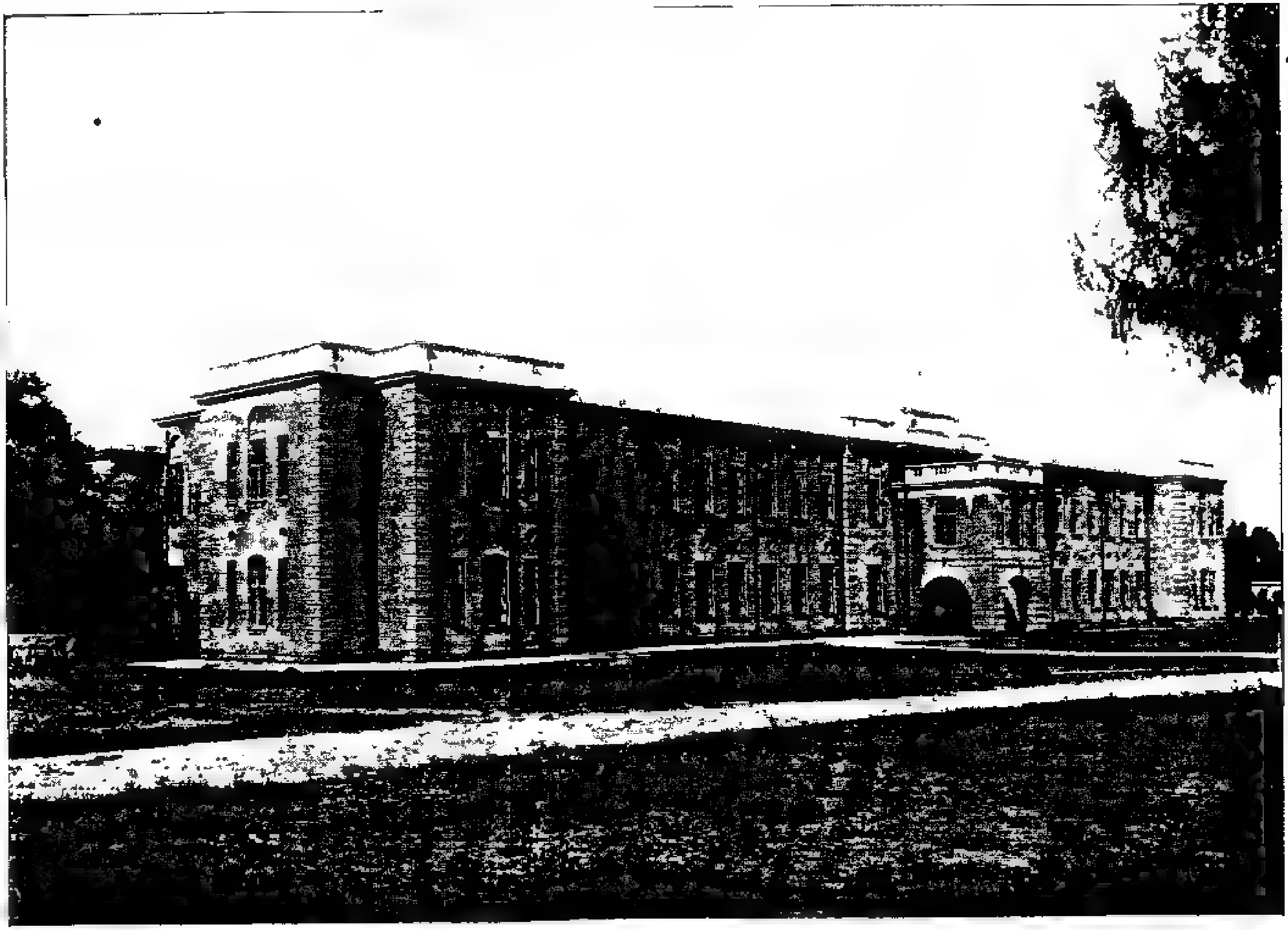


Photo M. . . . . .k pa., Thomason College, Roorkee

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Main Building.

VOLUME XL. NUMBER 12.

INDIAN FORESTER

DECEMBER, 1914.

THE FOREST RESEARCH INSTITUTE BUILDINGS DEHRA DUN.

Some 12 years ago Mr. Wroughton, the then Inspector-General of Forests, impressed upon the Government of India the need that existed for some central research bureau in order that opportunity might be given for the examination and co-ordination of various forest problems. He explained to Sir Denzil Ibbetson, who was at that time the Revenue and Agriculture Member, that immense sums of money were being lost, and still greater sums not realised owing to the ignorance of the Forest Department as to the Economic Value of Forest Products, due to absence of data such as would permit of more satisfactory working-plans being made and various other causes. He also pointed out that the Department was being starved for want of men and money. He was assured that the Government of India would carefully consider any proposal that was placed before them to remedy the defects that were so apparent. He resigned about that time and it was left to his successor, Mr. Eardly-Wilmot, to take up the question and place concrete proposals before the Government of India, and it is to his

energy and insistence that we owe the creation of the Research Institute.

Discussions as to plans, site, etc., took a long time, and it was only some 18 months ago that the buildings forming the Institute were begun. They are now completed, and we propose to give a short sketch of them.

They are situated in the healthiest and most beautiful part of Dehra adjoining the Cantonments. In order to afford sufficient room, two adjoining estates were purchased for a sum of about Rs. 1,25,000. On these estates already existed two houses, at present let to the Sylviculturist and the Botanist, and other buildings, the chief one of which is the Botanist's office, herbarium, etc., not very satisfactory and badly arranged, but which will serve its purpose till money is available to remove it and put up really satisfactory accommodation.

The buildings just completed consist of—

(1) A main Research Institute,

(2) A Chemical Laboratory with a separate Distillery and separate Gas House.

(3) A Workshop for the Economist.

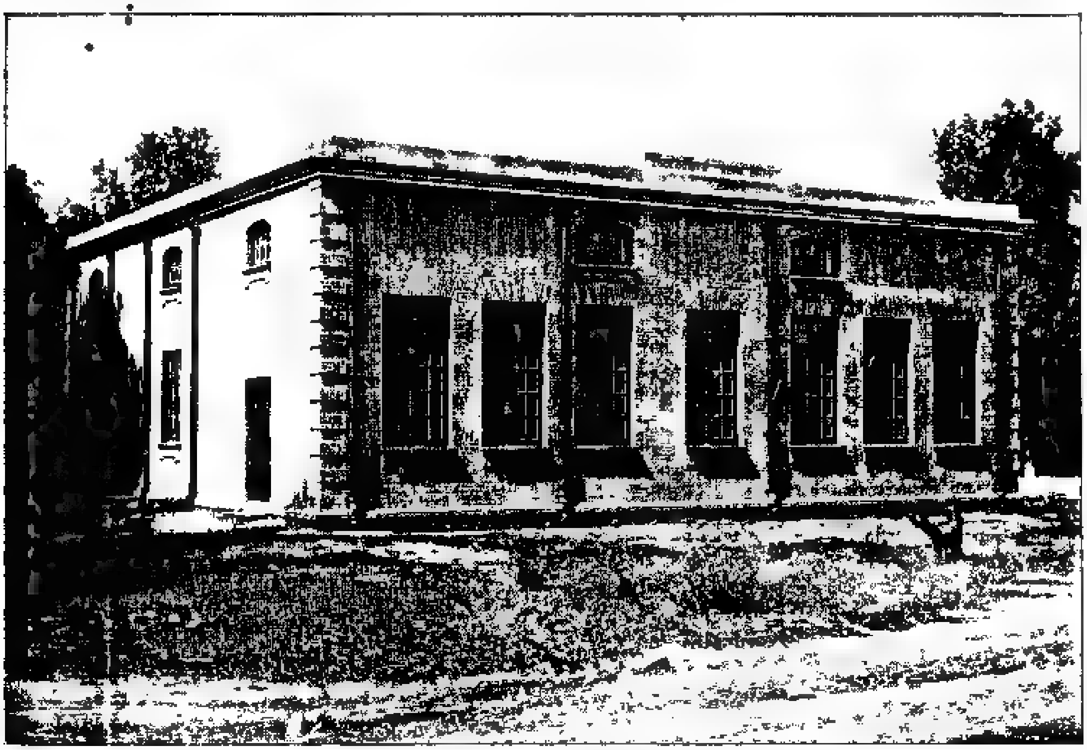
(4) A Workshop for the Entomologist.

(5) An Insectary.

(6) A Students' Laboratory.

The buildings are all uniform in style, of red brick. If their design had been left to the Local Public Works Department, the writer cannot help thinking that they would have been more satisfactory as an ignorance of local conditions has revealed one or two weak points in the architecture. The main building on the ground floor consists of Entrance Hall, 2 large Museums or galleries, some 90' × 30', for the Economist, accommodation for himself, his Assistant and his Office establishment, ditto for the Office establishment of the Chemist, a magnificent Library and a Lecture Room for the Provincial Service class adjacent to it, with a Waiting Room rendered necessary by the frequent visits paid by members of the outside public to seek information and advice On the upper floor are the Offices and Museums of the Sylviculturist and

Forest Research Institute, Dehra Dun.



Zoologist's Workshop.

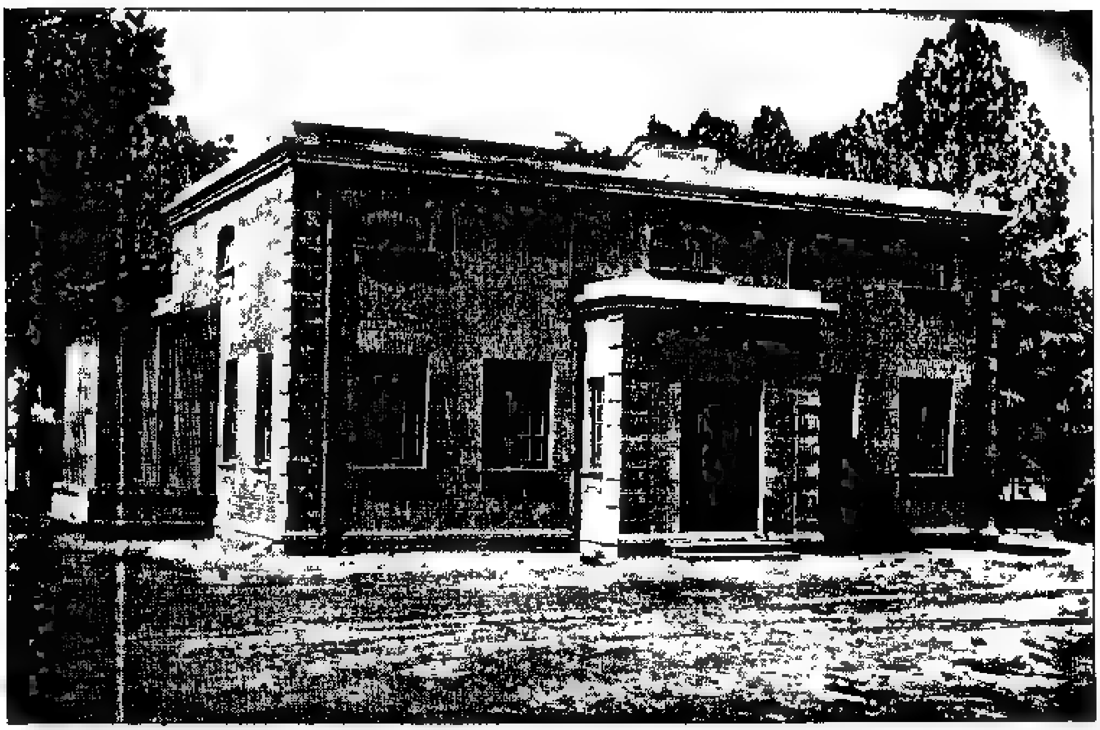


Photo Mecl l, Dept., Thomason College, Roorkee. Photo. by T B. Chitrakar.

Insectary.

Forest Research Institute, Dehra Dun.

Students' Laboratory.

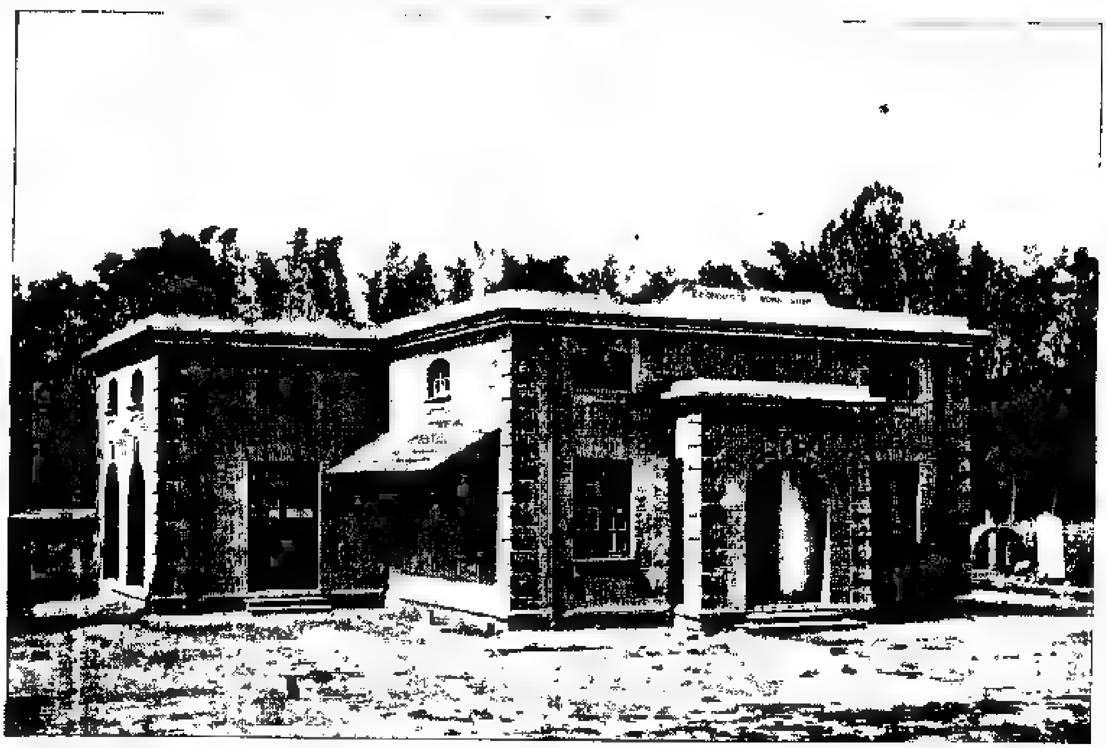


Photo Mechl. Dept., Thomason College, Roorkee. Photo. by T.B. Chitrakar.

Economist's Workshop.

Forest Research Institute, Dehra Dun.

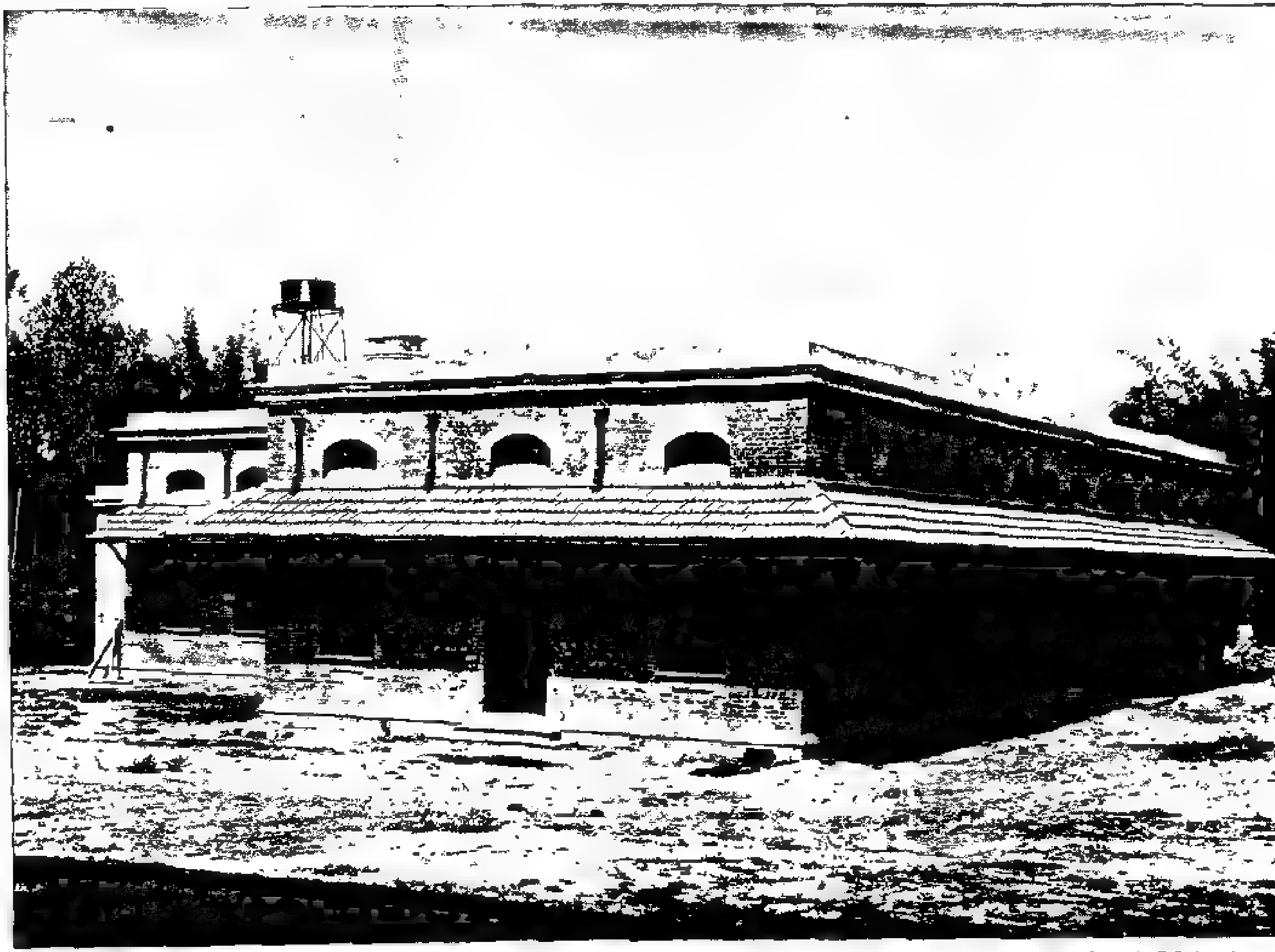


Photo Me... Dept., Thomason College, Roorkee. Photo. by T.B Ch...akar.

Chemical Laboratory.

Zoologist and their Assistants with a second large Lecture Room, Photo Exhibition Room, Instructors' Room, etc. Thus four branches, *i.e.*, those of the Sylviculturist, Economist, Chemist and Zoologist are housed in this building, the accommodation is ample, and for the first time in the history of the Institute these officers had reason to be satisfied with the space allotted to them.

The Chemist's Laboratory is a very good one. It is placed to the south-west of the main building close to the Economist's Workshop. The main room is fully fitted up with water and gas, a smaller room being similarly fitted which is reserved for volumetric analyses. Off the main room are two smaller rooms, one reserved for samples under examination and the other specially fitted up for combustion. There are five other rooms in the building which comprise one for optical work, a balance room, stores, office and branch library.

The Gas House is fitted up with Mansfield's gas generating retorts, while beside it there are two gasometres with a total capacity of 2,000 ft. The Distillery contains three stills of special design, which are all worked by a 10 N. H. P. boiler, there being also a smaller boiler of 3 N. H. P. for field work. There is also a small 1½ N. H P. boiler which runs a solvent extraction apparatus, etc., while there is a small plant for the distillation of water.

It will thus be seen that the Chemical Laboratory buildings are very complete. They have been carefully fitted up by Messrs. Mansfield of Calcutta. The Workshops of the Economist and the Zoologist were built from rough designs supplied by these officers and, though small, satisfy their requirements and will do so for many years to come. The Insectary is built somewhat on the lines of the one at Pusa The Students' Laboratory is fitted with sinks round the walls with water laid on so as to give every facility for practical work in Chemistry, while it can also be used for demonstration in Botany and Zoology.

Water is laid on to the buildings from a 2,000 gallon tank with a head of 60 feet. It is pumped up to the tank after being filtered.

The arrangement of the grounds is now being taken in hand under the able supervision of Mr. Troup, lawns being laid down, and choice exotics planted.

The buildings have at present a somewhat new and crude appearance, but this will in time tone down, and when a few creepers are to be seen on the walls their appearance will be much improved.

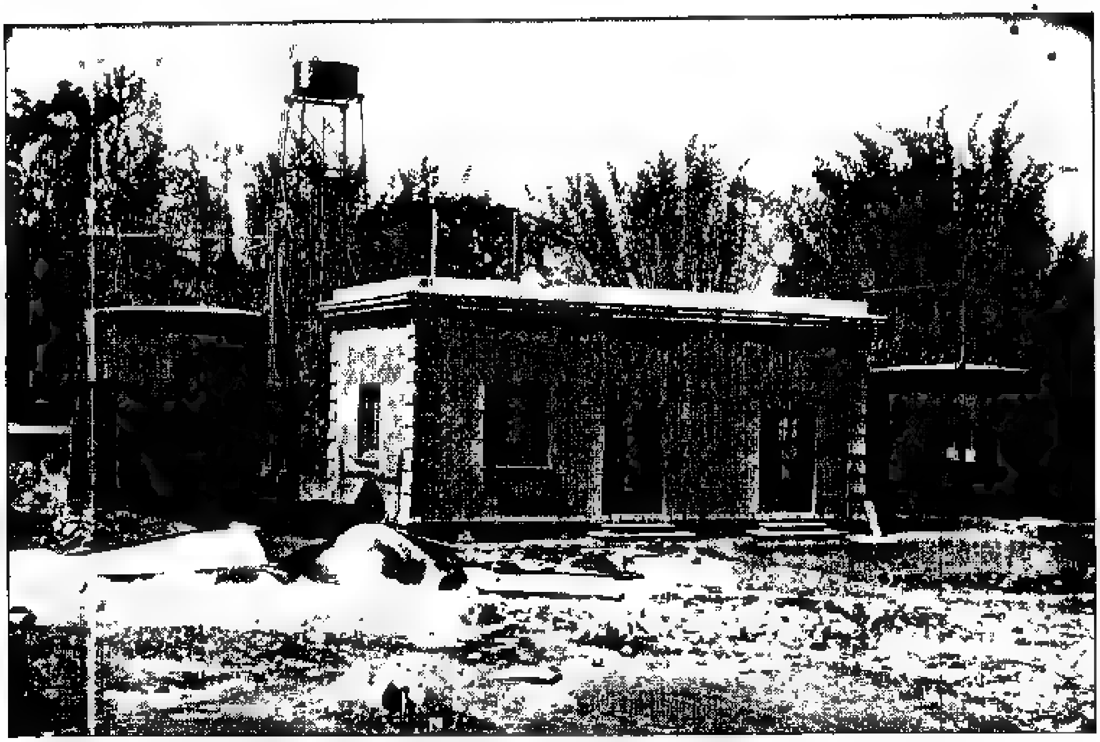
The further requirements of the Research Institute are more land and quarters with a mess house, tennis courts, etc., for the students of the Provincial Service class and a good house adjacent to them for an instructor and house tutor, and in time to come a good Botanical and Herbarium building. The first project is, we believe, now under the consideration of the Government of India ; it is imperative that it should be put through quickly as until this is done the students have much to contend with and do not have a fair chance of doing their best at Dehra Dun.

The grounds cover some 33 acres, and with the addition of an adjoining area for students' quarters it is hoped that we will soon have a compact estate of 45 acres with fine buildings on them which will be an enduring monument to the foresight of Mr. Wroughton and especially to the energy and insistence of Sir St. H. Eardly-Wilmot, who did more for forestry in India than any Inspector-General since the days of Sir Dietrich Brandis.

FOREST POLICY.

As a result of a recent examination in detail of the statement of Forest Policy contained in Government of India Circular No. 22-F., dated 19th October 1894 (Appendix V to the Forest Code), with a view to studying the applicability of that policy to present conditions, the following notes were made by the writer and may not be entirely without interest. It should be understood that they are the outcome of local experience and do not pretend to represent a comprehensive view of the situation. There has been such substantial development in forestry since the policy was formulated, that it is no matter for surprise that the general

Forest Research Institute, Debra Dun.



Gas Shed.

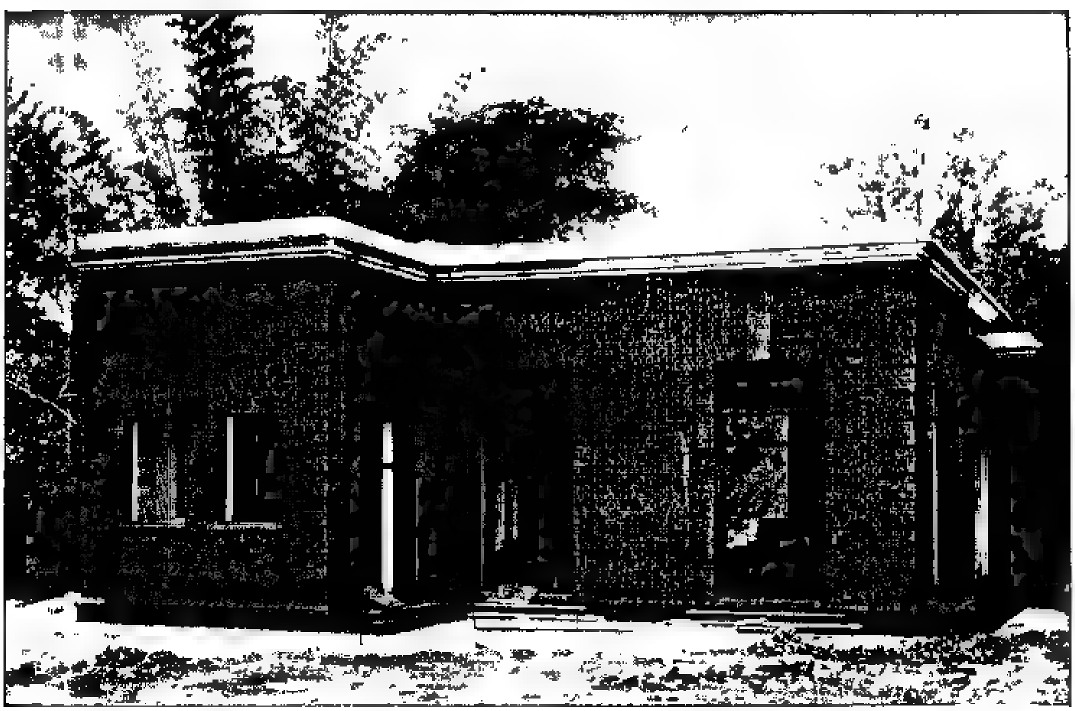


Photo Mechl. Dept., Thomason College, Roorkee. Photo. by T. B. Chitrakar.

Distillery.

outlook on forest matters should have undergone some change, and to suggest directions in which the policy might with advantage be broadened or modified conveys no reflection on its adequacy as applied to the conditions of its own time. The statement, moreover, contains certain ambiguities and misconceptions which ought to be removed.

Not the least of the former is as regards the attitude which it is intended that Government should adopt towards local interests. Take for example the keynote sounded in the first sentence of the second paragraph of the Circular:—"The sole object with which the State forests are to be administered is the public benefit" Standing alone the phrase is perfectly intelligible, but the sense is unfortunately marred by the subsequent interpretation of the word 'public' in a sense which does not ordinarily attach to it in the use of the phrase '*public interest.*' *The people of the tract within which the* forest is situated constitute a section of the community, and the interests of this section may be and are in fact not infrequently directly opposed to those of the community in general. The last paragraph of the Circular contains a far clearer exposition of the first essential of forest policy in providing that local requirements should be recognised and supplied "to the utmost point which is consistent with Imperial interests."

It appears again from the wording that the restriction as distinct from the regulation of rights as opposed to privileges was not contemplated. No doubt at the time it was very imperfectly understood that many so-called forest rights are strictly inadmissible as such at common law in that they involve the destruction of the servient estate, represented by the forest over which *they are exercised.* *The* exercise of such 'rights' over State forests seems to be in the public interest only in so far as the sacrifice of the natural resources of a country is justifiable by temporary as opposed to permanent considerations of policy. If it is possible to get rid of them, there can hardly be two opinions as to whether it is in the public interest to do so.

Take finally the concluding sentence of the paragraph:—"This regulation and restriction (of rights and privileges) are justified only

when the advantage to be gained by the public is great." The vagueness of the expression is out of place in a document which should be above all things precise, and one may enquire, moreover, whether regulation and restriction are not justified when the advantage to the public is *appreciable*. One may suggest the modification of the paragraph somewhat on the following lines :—

The sole object with which the State forests are administered is the public benefit. All measures relating to the regulation and restriction of rights, and the grant, withdrawal and restriction of local concessions should be referred to this test. The interests of individual persons, classes or communities should be considered *only in so far as such interests may directly or indirectly coincide* with those of the community at large. It is impossible to lay down definite rules and each case must be decided on its merits by the authority competent to deal with it.

Paragraphs 3 and 4 call for no special comment.

In paragraph 5 the important question of the satisfaction of local customs of user comes again to the fore. The initial step in this connection would seem to be the determination as to whether anything in the nature of a legal or moral right exists. If such a right is found to exist it should next be considered whether it is in the public interest that the satisfaction of the right in a regulated form should continue, or that the right should be wholly or partially commuted. Except in the case of established rights, I fail to see why special benefit should be conferred on any person (or class) at State expense solely in virtue of the fact that he resides in the vicinity of a State forest, as the paragraph can be interpreted to suggest. If it is in the public interest that he should so réside, or that he should fulfil any useful function by so residing, it is perfectly legitimate to grant concessions in order to induce him to do so. Communities residing on the forest borders are exceptionally favourably situated for the fulfilment of their requirements in the way of forest produce, which must always be cheaper on the spot than when it has to be conveyed to a distance, and there seems no reason why this advantage should be added to artificially without a definite *quid pro quo*.

Before leaving the subject attention may be drawn to the danger of basing privileges and concessions on residence alone. The purpose, which, if the views expressed above are adopted should regulate the grant of all concessions is more likely to consist in the introduction into or maintenance in, the tracts bordering the forest of some special class of persons of particular utility than of a miscellaneous public of varying occupation. In the former case the concession should be distributed amongst individuals and communities according to the extent of useful service rendered. For example, if it is desired to attract cultivators, the basis adopted for the concession might be the area cultivated by each individual, in the case of cattle-breeding, the number of useful animals owned by each individual, and so on.

The discussion of the desirability of providing grazing facilities in forests of class (*b*) may conveniently be postponed to a later stage of this note.

The sentence " It should be distinctly understood that considerations of forest income are to be subordinated to that satisfaction (the needs of the local community)" appears to convey a rather narrow and misleading view. Forest income is but one of the many considerations which must be taken into account in determining how a forest is to be managed, but the extent to which it should be subordinated to other considerations ought to be measured by the degree in which those considerations contribute to the public utility There is no virtue in sacrificing revenue unless a definite equivalent advantage from so doing can be demonstrated.

The most advantageous adjustment of the available timber supply between industrial and agricultural demands must always be a difficult problem of administration, and there is nothing special to quarrel with in the remarks on this subject which conclude paragraph 5. The mention of 'merchants' is perhaps liable to cause misunderstanding of the function of the contractors who purchase timber in the forest, which is mainly distributive. With our existing forest organisation, direct dealings between the Department and the consumer would be even more

impracticable than at present if the whole of the produce from the State forests were assigned to meet the agricultural demand.

Paragraph 6 as qualified by paragraph 7 reads reasonably enough, but the question may be raised whether the fourth condition of the latter paragraph has not now assumed such importance in many regions of India proper as to render the claims of forest preservation paramount Whatever may have been the conditions at the time that the policy was formulated, a very large proportion of the produce from the State forests is now absorbed in the country, and there is no likelihood at all events of a decrease in the demand. The supply may show an increase up to a certain point consequent on improvements in forest management, but, on the other hand, the available sources of supply are being steadily limited by the destruction of forest tracts under private control and in the territory of Native States. The situation in the Nepal Terai alone is enough to cause grave anxiety. These considerations, to which may be added the need now recognised for afforestation on an extensive scale, suggest that our policy might well be re-drafted in a spirit more sympathetic to forest preservation.

The attitude towards local interests and forest revenue displayed in paragraphs 8 and 9 has already received sufficient attention, but an important point arises in the latter paragraph in respect of the practice of grazing in minor forests. There is a very prevalent and deep-rooted misapprehension that land bearing tree forest can be utilised simultaneously for the provision of grazing and the production of timber and fuel. Any forest officer with experience of forest pasturage is well aware that continuous grazing in tree-clad areas acts as a bar to natural reproduction and consequently renders a sustained yield of timber and fuel impossible. This is fully confirmed by Continental authorities—Great Britain has until recent years been a century or two behind the times in forest matters and moreover has never had occasion to deal with this particular problem on an extensive scale—and the conclusion has long since been reached that the only method of combining forestry and grazing in a given

area is by the maintenance of the forest and pasturage in distinct and independent masses, subject to distinct and separate treatment. An essential feature of the system is provision for the periodic closure of the forest areas for purposes of regeneration. Grazing in tree forest has been condemned in principle as a destructive mediæval survival, and its abolition in practice is proceeding apace, the process being materially assisted by the inclusion in educational curricula of instruction in the elements of forest protection. In India, however, forest grazing is extensively practised, and a protracted struggle for the recognition of its evils has been an important feature in the history of the Forest Department. Success has been achieved in the closure of many of our more valuable forests, but large areas of minor forests remain open to grazing, and the fate of these will have to be decided sooner or later. Either they will have to be closed and maintained as forest for the supply of timber and fuel in satisfaction of the agricultural demand, or disforested and converted into pasturage pure and simple, or as a possible compromise they might be partially disforested and managed on the French silvo-pastoral system, the essential features of which have been indicated above. Whichever of these alternatives is adopted the utility of these areas, at present confined to the supply of a purely nominal quantity of timber and fuel and the provision of pasturage of indifferent quality at best, is likely to be substantially increased; but considering the importance of maintaining a source of timber and fuel supply to meet the actual and prospective demands of the agricultural community, it seems desirable that no area of minor forest, which can successfully contribute to the fulfilment of this object, should be sacrificed for any consideration short of an imperative need, unless it can be shown that the possibilities of converting unstocked waste land into pasturage, whether by State or private agency, have been completely exhausted, the sacrifice of the nation's timber and fuel supply to satisfy the immediate needs of an industry of which the ultimate indispensability is distinctly open to doubt would hardly be an act of responsible statesmanship.

It is clear from perusal of Dr. Voelcker's work that he realised to some extent the incompatibility of grazing and timber production. He is explicit on the point as regards large timber, though the logical application of the arguments he employs in this connection to the production of all kinds of timber and fuel seems to have escaped notice. His attitude towards grazing in forests devoted to the production of small timber and fuel is throughout somewhat vague, and this, with the fatal phrase "fuel and fodder reserves" is sufficient to account for the misapprehension referred to in the foregoing, in so far as this misapprehension pervades the statement of policy, which is obviously based to a large extent on Dr. Voelcker's views. It would be instructive to comment in detail on Chapters VIII and IX of "Improvements of Indian Agriculture," but space forbids.

The essence of the matter as regards minor forests is this: either the forest must go or grazing be excluded. It is no sort of policy to maintain unproductive forests, and it will have to be considered in each case whether the public interest will be better served by disforestment or closure.

Paragraph 10 is chiefly noteworthy in that the conception of grazing as an industry appears to be absent. In the Oudh submontane regions at all events the number of plough cattle grazed in forest pastures is negligible, and stall-feeding for such cattle is the general rule. Practically the whole of the cattle grazed in the forests are kept for breeding purposes, and the industry is largely in the hands of a particular class the interests of which are by no means identical with those of the general population of the tracts bordering the forest areas. Large land-owners do not disdain to participate in the profits of this industry which is in fact very lucrative. The chief evil which results from subsidising the industry by the grant of grazing at nominal rates is that private land-owners are deterred from giving facilities for pasturage; they cannot charge rates higher than those prevailing in the State forests and the maintenance of grazing grounds in the circumstances is unprofitable. The levy of nominal fees amounts in fact to a species of price-cutting, a practice which one may imagine it to be the consistent policy of Government to avoid.

In reference to the last sentence of paragraph 10 it may be remarked that the fact that a cow or buffalo may be a necessity to a cultivator is not in any way relevant to the question of the necessity of forest pasturage to a cow or buffalo.

The passage in paragraph 11 ". . . . the object of excluding grazing from the preserves is the advantage of the neighbourhood" deserves some notice. There is every reason to believe that a very large potential demand exists for produce which might be supplied from the minor forests of the Oudh submontane regions if the greater part of these forests were not rendered unproductive by grazing The fact that villagers bring their carts, in slack seasons when the latter are not required for other works, for distances of forty and fifty miles in order to obtain materials for house construction, suggests that, with effective means of distribution, a very large proportion of the produce both of the major and minor forests could be absorbed by the surrounding population. A glance at the quantities of material supplied to the inhabitants of the concessionist villages within the three-mile limit will convey some idea of the enormous field of utility which our forests could be made to serve by subordinating the immediate interests of an infinitesimal section of the community to those of the public at large. Until some idea of forest protection can be instilled into the owners of such private forests as survive, the "local supply of fuel independently of the reserved area" is likely to show a steady decrease; and if by the time that this supply has been finally exhausted, the minor forests have also succumbed to the grazing demand the situation will be serious indeed. A further point worth comment is that the fact that produce is sold to the highest bidder is not in the least likely to prejudice the local supply, and the observations on this point suggest the same misconception of the function of the forest contractor as has been made the subject of remark in paragraph 5. Produce is, as a rule, exported to foreign markets only in so far as it is in excess of the local demand, and such markets are not by any means confined to large towns, but also include such rural regions as may be connected by rail with the source of supply.

The natural pasture grounds of the Oudh forests, which may be classed as a whole among the pasture-lands mentioned in paragraph 12, contain extensive scattered tracts of valuable tree forest, which *unfortunately* are *steadily disappearing* as a result of grazing and fires. As such tracts contribute largely to the amenities of the pasturage, their protection on that ground alone is desirable, and if protected they would also become a valuable source of small timber and fuel.

That pasture-lands require careful and systematic management no less than forests is a conception which at the time the policy was formulated was doubtless not very far developed The importance of such management is, however, becoming increasingly recognised, and its need might well be emphasised in case of revision of our general forest policy.

Paragraph 13 requires no special comment, though much might be written on the text of the comments on the *character* of forest subordinates This is, however, hardly relevant.

The point raised in paragraph 14, that grazing should not be regarded primarily as a source of revenue, has been sufficiently dealt with in pointing out the dangers which attend the grant of grazing facilities at rates considerably below the market value of those facilities.

The question of the desirability of constituting forest areas as 'Protected' or 'Reserved' forests is one which, having no practical experience of the former class of forest, I should hesitate to discuss. Perhaps one may incline to the view expressed in Dr. Voelcker's book, p. 142, para. 166, which favours the constitution of Reserved Forests in all cases.

With regard to the last paragraph, there is little doubt that the phrase 'abuse of concessions for commercial purposes' can be aptly applied in many instances to the case of grazing concessions, though there is no question of fraudulent intention. It is a pity, moreover, that the advice as regards limiting the term for which concessions are granted, has not been more extensively adopted.

I *wish to make it clear that nothing, in the foregoing remarks,* is intended to suggest that it is in any way desirable to divert the State forests from their primary function of supplying local demands, in so far as those demands are consistent with forest preservation I hold, on the contrary, that the population of the tracts bordering on the forests should have the first claim on the supply. It is merely urged that leaving out of the question the case of established rights and the grant of concessions for a particular object of public utility, the local population has no right to be supplied on terms more favourable than the general public, except in so far as more favourable terms are secured by the fact of its proximity to the source of supply. Secondly, that the sacrifice of natural tree-growth to destructive local practices, such as grazing, can only be justified by the following combination of conditions : (1) that the permanent maintenance of the practice is imperative in the public interest, (2) that the possibilities of providing for the practice elsewhere than in tree forest tracts have been completely exhausted, and (3) that the supply of timber and fuel is more than sufficient for the present and prospective needs of the community. Artificial reafforestation is a most expensive and often unsatisfactory method of replacing natural forests, and if our present forest tracts are likely to be needed any time within the next two centuries, it is a most spendthrift policy to sacrifice a single acre of them unnecessarily. A report written in 1876, by one who posed as an authority on the relationship *between forestry and agriculture, concludes with the remark :* " To canvass for the fairly earned thanks of the present generation is surely more to the purpose than discounting the unproved gratitude of the future." When the thanks of the present generation are earned by the sacrifice of the natural resources of the country the doctrine is not one which may be expected to improve with age.

To conclude, the whole question is one which can be solved only by careful thought, patient discussion, and the fair consideration of all points of view There should be plentiful material, derived from the experience of twenty years, on which a revision

of policy might be based, and the provincialisation of forest revenues seems to emphasise the need for an up-to-date national forest policy

J. N. O.

EXTRACTS.

SYNTHETIC CAMPHOR ON A COMMERCIAL SCALE.

A corporation is being formed in Philadelphia for the manufacture of synthetic camphor from turpentine. While synthetic camphor has been produced in a restricted way in Germany for some time, this will be its first production in the United States.

"It was in the smelting works of Harry K. Fort & Co., on North American Street," says the *Public Ledger*, Philadelphia, "that the experimental synthetic camphor was produced. After experiments running over a long period, this camphor was used successfully in the manufacture of celluloid by a concern in Newark, New Jersey. An expert chemist, conspicuous in the work of compiling the United States Pharmacopœa, pronounces it true camphor, with all the chemical characteristics of gum camphor. Now, it is asserted the experimental stage has been passed and a manufacturing plant is being sought. It is intended to commence with a daily output of 2,500 lbs. equivalent to about one-fifth of the consumption of gum camphor in the United States. To make 2,500 lbs. of camphor will require about 3,200 lbs of turpentine. The cost will be about one-half that of refined gum camphor."

The chief use of camphor is in the manufacture of celluloid, and it is also employed in the production of explosives and artificial leather. Manufacturers of these articles have frequently been handicapped by the uncertain deliveries of the Japanese monopoly. The condition of the camphor-using industries has recently become more acute by reason of the introduction of celluloid manufacturing on a large scale in Japan, the threatened exhaustion in two or three decades of the camphor forests of Formosa, and by the inability to secure the synthetic product in sufficient quantities from Germany.—[*Commercial America.*]

MATCH TRADE OF INDIA.

In our issue of 10th September we published some statistics relating to the match import trade. In that connection the following extracts from a report sent by Mr. Henry D. Baker, the American Consul at Bombay, to the Department of Commerce at Washington, will be read with interest :—

Matches are one of the most indispensable articles of import into India, as nearly all of the millions of people within this Empire, whether rich or extremely poor—the latter being the condition of the vast majority—are obliged to make more or less constant use of matches. Not only are matches required for ordinary domestic and industrial purposes, but for lighting cigarettes, pipes, etc., most people of both sexes being smokers. As the ordinary materials smoked are exceedingly inferior and cheap, the cost of matches with most native smokers is an item of considerable expense.

The latest figures of Indian import trade, for the 11 months from April 1st, 1913, to February 1st, 1914, showed imports of matches for that period amounting to about 2,745,000 dollars. For the entire year they should run well over 3,000,000 dollars.

The principal countries supplying India with matches, according to quantities (in grosses) are as follows, for the period of 11 months from April 1st, 1913, to March 1st, 1914: Sweden, 3,351,684; Norway, 818,524; Germany, 184,367; Belgium, 279,812; Austria-Hungary, 1,202,082; Straits Settlements (including Labuan), 79,327; Japan, 6,672,560; other countries, 163,471; total, 12,751,827.

A recent issue of the *Indian Agriculturist* discusses the Indian match trade as follows :—

Until recently matches "made in Norway" or "made in Sweden" monopolised the Indian market. The Japanese, however, have entered this field of industry, and at present the Japanese article is a formidable competitor in India of the Swedish match. The Japanese article is undoubtedly inferor to the Scandinavian, but it is cheaper, and cheapness, even when accompanied by inferiority, is a great recommendation in the Indian market

Considering the success of Japanese matches in India, the question arises: Why should not we, in this country, attempt to supply our own needs in this department? Among India's vast forest areas some tree could, without doubt, be found which would be suitable for the manufacture of match sticks, while the other products necessary for the manufacture could easily be obtained either locally or from abroad. At any rate it would not be difficult to turn out an article as good if not better than the flimsy Japanese match. The attempt has already been made on a small scale in India, and its small success was probably due to the lack of capital as well as of efficient management. In Burma, however, a match-making company has recently been floated with considerable capital and under European management, and there are already some indigenous factories which are working with moderate success. Burma is, it is said, the province which consumes the largest quantity of matches, and this is very likely true, for there the young and old men, women and children, are all smokers. Burma consumes annually matches to the value of nearly one-sixth of the total import into British India.

Lately the influx of Japanese matches has enormously increased owing to the cheap sea freights and the Japanese league of manufacturers and shippers and to the formation of a regular Japanese merchant vessel fleet sailing from Japan to Calcutta *viâ* Rangoon. There the Burma market is now flooded with cheap Japanese matches of various kinds and qualities. There is now a tug-o'-war between cheap and inferior quality Japanese matches (even then we should say that we sometimes come across Japanese matches which are equal to and in some respects better than any other foreign brand) and high-priced superior quality Europe ones.

Burma with its abundance of timber supply and many other advantages is one of the best places for the match industry. The India Government Forest Department reports as follows:—

"Burma would probably be the most profitable province in which to undertake the manufacture of matches. (1) There is abundant supply of suitable timber at cheap rates; (2) the country

is well supplied with streams for floating rafts; (3) an up-country factory might obtain a market for matches in western China, etc. Following are some disadvantages: (1) Labour is expensive and one has to depend on imported Indian labour; (2) means of communication other than waterways are backward, especially in the neighbourhood of forest tracts; (3) competition with Japanese matches, etc."

These reports on the suitability and success of the match industry encouraged some moneyed people in Burma, and the result was the starting of two good-sized and well-equipped match factories within the space of two years. Of these ventures one is in Rangoon and is owned by a Chinese; the other under European management is in Mandalay. The Rangoon factory employs over 250 labourers, half of whom are Burmans and half non-Burmans.

The matches are of second quality, but they sell at the same cheap prices as the Japanese do.—[*Indian Trade Journal.*]

REAFFORESTATION.

A note in *The Surveyor* of New South Wales gives some useful information regarding methods pursued for the reafforestation of depleted hardwood areas in the coast districts of New South Wales. The condition of forest clearance there must be similar to those holding in India, where it would never pay to clear a section of forest in the ideal way, that is, by a thorough working out of a forest area before breaking fresh ground. There is but small demand for timber for minor purposes in New South Wales owing to the paucity of the population. Demand is in the direction of heavy timber of good quality from the best trees to meet requirements for the export trade as well as for local building purposes; and this connotes considerable waste in forest operations, since not more than 25 per cent. of the trees have a commercial value. As a consequence the working of a forest means really the removal of this 25 per cent. and a small percentage more to meet

minor demands, while much timber is left behind which though useful is not wanted. In India, of course, with its dense population, there is considerable demand for timber for minor local purposes, but the population is a poor one which must have its timber cheap, and it would never prove a paying proposition to transport this cheap timber over long distances from the forest to the door of the consumer. The treatment of such forests in New South Wales is to ring-bark the timber that is left, fell the scrub and weeds and then fire to clear the forest floor. Regeneration follows from the seeds of trees that have been left standing, it being noted that a good forester will always leave standing a certain number of valuable trees for this very purpose of shedding good seed. Trees that have been ring-barked only die slowly, those both ring-barked and sapped die more rapidly. Forestry does not demand the latter treatment, and it is a remarkable fact that a ring-barked tree will produce, ripen and shed large quantities of seed before dying. This seems to be one of nature's provisions to assist propagation, the phenomenon having been observed in Australia even under other circumstances. For instance, if the bark is entirely stripped from the trunk of a wattle tree before the blossoming period, it will not die before it has blossomed and produced a crop of seed; again trees, generally, when dying from an injury or natural decay produce large quantities of seed before death. Ring-barking is carried out just after the dormant period, that is, in spring, because then the root system is ready to supply nourishment and will throw out dense growths from the roots, which is an advantage to saplings, as a dense undergrowth not only protects them but encourages the most vigorous among them to shoot up straight with a minimum of branching. The time for firing is when the leaves and minor branches of the ring-barked trees have fallen and the bark has loosened upon the dead trees, preferably in the spring. At this time the seed in the ground will be saved by the moisture in the soil, and though the conflagration be severe no harm will result beyond destroying a small proportion of the trees left for seeding purposes, and scorching the leaves of the rest. Mature, trees

rarely suffer permanently from the effects of a fire, but young trees are usually severely injured. After firing all browsing in the forest is stopped, patches that show no signs of regeneration are sown with seed scattered broadcast, and noxious growths are destroyed. If regeneration includes large areas of inferior species to the exclusion of the more valuable ones, the former are rooted out and seed scattered of the desirable species. The area should then be left alone, except by way of removing growth that is palpably injuring the saplings, until the time has arrived for thinning. The first thinning is effected on a small scale only, but subsequent ones more freely, the timber removed coming in as poles and props which have a market value. Operations such as these result, if judiciously carried out, in a regenerated forest of even age.—[*Indian Engineering.*]